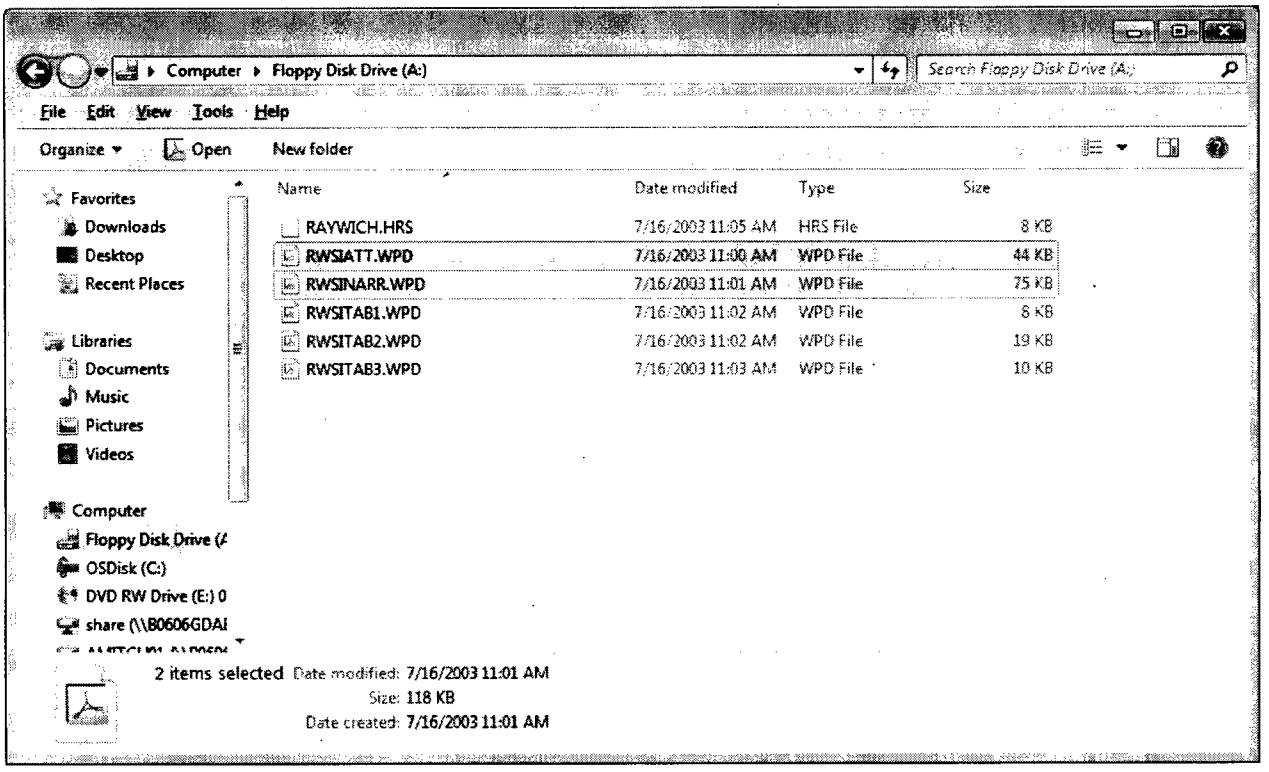

TARGET SHEET

SITE NAME: RAY WICHERT PROPERTY

CERCLIS I.D.: OKD987095049

TITLE OF DOC.: SITE INSPECTION PRE-SCORE ATTACHMENTS FOR SITE INVESTIGATION REPORT OF RAY WICHERT PROPERTY

DATE OF DOC.: 01/01/1111

NO. OF PGS. THIS TARGET SHEET REPLACES: UNKNOWN

SDMS #: 976148

CONFIDENTIAL ?		**MISSING PAGES ?**	
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CASE #:		**SDG #:**	

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ATTACHMENT A
WASTE CHARACTERISTICS

There are two primary waste sources known to be present on the Ray Wichert Property at the present time: (1) underground storage tanks (USTs) and their associated piping and motor fuel dispensers, which are lying on the ground surface in the southern half of the basin on site; and (2) numerous scattered waste piles of construction debris and other solid wastes, which are lying on the ground surface in the northern half of the basin. Some of the construction debris may be contaminated with radium (References **4**, **24**, and **25**).

Four underground storage tanks, the piping (lines) for those tanks, and three fuel dispensers are lying on the ground surface in the southern end of the basin on site. Three of the USTs appear to be 10,000 to 12,000 gallon tanks, being approximately 8 to 10 feet in diameter by approximately 20 feet in length. The fourth UST is smaller, perhaps 1,500 gallons in volume, and may have been a waste oil tank. All four USTs are metal tanks that are completely rusted, and no labels, engravings, or other markings are visible on them to identify their age, construction, contents, volume, or ownership. At least half of the openings for piping on each UST are open, while the other half of the openings are plugged. Corrosion has eaten completely through each UST, leaving small holes which are located mostly along the seams at the ends of each tank. There was no odor of petroleum hydrocarbons around the tanks, and no hydrocarbon stains are present on the soil around the tanks. It is not known if petroleum hydrocarbons are still present in these tanks in the form of sludge, liquid, or vapor (Reference **4**).

Piping for these four USTs is lying on the ground, immediately north of the tanks. Three motor fuel dispensers are lying on the ground, just south of the tanks. Metal poles and signs, including two Texaco signs, are lying on the ground near the fuel dispensers and USTs (Reference **4**).

The four USTs, three dispensers, and piping appear to have been removed from the dispenser island area on the high, level ground at the south end of the site. The dispenser island clearly shows that three dispensers had once stood on it. Thus it is reasonable to assume that the three dispensers lying on the ground in the south end of the basin on site were removed from the dispenser island on site. No trace of fill pipes for USTs was seen on the ground around the dispenser island and buildings on site. Rusty scratches on the concrete pad around the dispenser island suggest that USTs may have been dragged across the pad after they were removed from the ground. Thus it is reasonable to assume that the four USTs lying on the ground in the southern end of the basin on site were removed from the ground in the vicinity of the dispenser island. No stains of petroleum hydrocarbons are present on the concrete pad or gravel around the dispenser island and buildings, but oily liquid is present in the grease trap outside the large door on the north side of the large building (Reference **4**).

ATTACHMENT A
WASTE CHARACTERISTICS (Continued)

An aerial photograph shows that there was no development on the site in 1974 (Reference **16**). Thus the USTs were not installed on the site until some time after 1974. The tanks were removed from the ground in December, 1998, and the tank closure report indicates that no hydrocarbon contamination of soil was discovered at the time of tank removal (Reference **26**). Thus there is no evidence of hydrocarbon contamination in the soil or groundwater at the south end of the site.

Numerous waste piles of construction debris and other solid wastes are scattered around on the ground surface in the northern half of the basin (north of the dilapidated fence) on site. Almost all of the waste in these waste piles is construction (or demolition) debris. Several old hot water heaters, and possibly a few small oil field separator vessels, are also present at one location among the waste piles. Only a few buckets and other containers are present among the waste piles. One container appeared to have contained lubricating oil. The construction debris consists of bricks, concrete, asphalt, and minor amounts of scrap lumber and scrap metal. Traces of linoleum on flat slabs of concrete are the remains of interior floors of a building. Fragments of brick walls, concrete floors, and cinder block foundations are abundant, and one slab of concrete bears the date, "10-17-27". Shingles are present on roof fragments. These scattered waste piles cover a surface area of approximately 20,000 square feet. [The waste piles are scattered over a total area of approximately 100 feet by 800 feet, and are estimated to cover not more than 25% of that total 80,000 square foot area.] Some of the solid wastes from these piles are lying on the bed and banks of the intermittent stream on the eastern margin of the site. No stains are present on the soil around these numerous waste piles (Reference **4**).

At least some of the demolition waste on the Ray Wichert Property was derived from the Sooner Dial site in Clinton, Oklahoma. Some of the Sooner Dial demolition waste may be contaminated with radium. Radiation surveys of soil and waste piles on the Ray Wichert Property were conducted by the Oklahoma State Department of Health and by the OES. These radiation surveys discovered that radioactivity exceeded background levels at certain locations among the soil and waste piles (References **4**, **24**, **25**).

The preliminary assessment report for the Ray Wichert Property (Reference **6**) said that six unmarked drums of unknown contents were present on the site near the present location of the four USTs. No traces of these drums or their spilled contents were seen during a reconnaissance of the site by OES personnel on May 1, 2003 (Reference **4**).

The OSDH conducted two radiation surveys of the Ray Wichert Property and found radiation levels among the waste piles that ranged from approximately 100 μR/hr up to 350 μR/hr. Soil samples collected among the waste piles during the radiation surveys were found to contain 18 to 385 pCi/gm of radium. Details of these OSDH radiation surveys and soil sampling events are described in References **25** and **27**.

ATTACHMENT A
WASTE CHARACTERISTICS (Continued)

Four soil samples were collected at the time of UST removal and closure on the Ray Wichert Property on December 30, 1998 (Reference **26**). The samples were collected at the east ends of the USTs, which is most likely the downgradient end for each tank with respect to the direction of groundwater movement. [Shallow groundwater most likely moves east-northeast across the site, moving from higher ground toward the intermittent stream on the eastern margin of the site.] However, the soil depth interval from which each sample was collected was not recorded in the closure report. The samples were sent to Isotek Laboratory Services in Oklahoma City for analyses. The samples were analyzed for benzene, toluene, ethylbenzene, total xylenes, volatile total petroleum hydrocarbons (gasoline range organics), and extractable total petroleum hydrocarbons (diesel range organics). None of these hydrocarbons were detected in the samples.

Analyses of the five surface soil samples collected among the waste piles by OES revealed that four inorganic analytes were present in one or more samples at a concentration of three or more times their concentrations in the background sample or at a concentration in excess of the sample quantitation limit (**Table 1** and Reference **6**). These four analytes were arsenic, cadmium, calcium, and mercury. The concentrations of cadmium, calcium, and mercury in these samples did not equal or exceed the EPA's Region 6 Human Health Medium-Specific Screening Levels (Reference **28**). Arsenic exceeded the screening levels for residential and industrial cancer risk in sample 4 (References **6** and **28**). However, its concentration in sample 4 (4.7 mg/kg) is well within the normal concentration range of arsenic in uncontaminated soils (References **29**, pp. 83 and 84, and **30**), which suggests that the arsenic in sample 4 is derived from natural sources rather than from the waste piles on the Ray Wichert Property.

Analyses of the five surface soil samples collected among the waste piles revealed that fourteen semivolatile organic compounds were present in one or more samples at a concentration of three or more times their concentrations in the background sample or at a concentration in excess of the sample quantitation limit (**Table 2** and Reference **7**). With the exception of carbazole, all of these compounds are polynuclear aromatic hydrocarbons (PAHs). Six of these PAHs are present in one or more samples at concentrations that exceed one or both of the following EPA Region 6 Human Health Medium-Specific Screening Levels: the residential risk-based screening level for contaminants in soil; and the industrial risk-based screening level for contaminants in soil (Reference **28**). The six PAHs that exceed one or both of these screening levels are benzo (a) anthracene, benzo (b) fluoranthene, benzo (k) fluoranthene, benzo (a) pyrene, indeno (1,2,3-cd) pyrene, and dibenzo (a,h) anthracene. These PAHs are marked with one or two asterisks (* or **) in **Table 2**, depending on whether they exceed one or both of the risk-based screening levels (residential and industrial) in a given soil sample.

ATTACHMENT A
WASTE CHARACTERISTICS (Continued)

The presence of PAHs in the soil samples collected among the waste piles is difficult to explain. PAHs are commonly found in petroleum products, such as gasoline and lubricating oil (Reference **31**). However, petroleum products and stained soils were not seen among the waste piles, and only a few containers were present among the piles (Reference **4**). The soil samples were *not* collected from the vicinity of the underground storage tanks lying on site. Furthermore, no PAHs were present in the field and equipment blank samples collected at the site during the soil sampling event (Reference **7**). Thus there is no obvious source among the waste piles for the PAHs present in the soil samples.

Analyses of the five surface soil samples collected among the waste piles revealed that seven pesticides were present in one or more samples at a concentration of three or more times their concentrations in the background sample or at a concentration in excess of the sample quantitation limit (**Table 3** and Reference **7**). These seven pesticides were dieldrin, endrin, endosulfan II, 4,4'-DDD, 4,4'-DDT, endrin ketone, and alpha-chlordane. These pesticides did not exceed EPA Region 6 Human Health Medium-Specific Screening Levels in any sample (Reference **28**).

RADIATION SURVEY

On May 1, 2003 the OES used a Ludlum Model 3A Survey Meter with a Ludlum model 44-9 pancake-type gamma ray detector to screen the surface soil and solid waste piles in the topographic basin of the Ray Wichert Property for radioactivity (Reference **4**). Background radiation in the basin ranged from 10 μR/hr to 60 μR/hr. The radioactivity of all surface soil surveyed in the basin ranged from 10 μR/hr to approximately 50 μR/hr. The radioactivity of almost all solid waste (demolition debris, linoleum, asphalt, concrete, brick, scrap metal, scrap lumber) surveyed in the basin ranged from 10 μR/hr to 60 μR/hr. Only one waste pile near the center of the northern half of the basin was found to contain debris with radioactivity exceeding the maximum background level of 60 μR/hr. Two small slabs of concrete debris in this waste pile were found to have radioactivity of up to 600 μR/hr, which is ten times the maximum background level on site. These high levels of radioactivity suggest that the demolition debris in this waste pile may have come from the Sooner Dial site in Clinton, Oklahoma (References **25** and **27**).

ATTACHMENT B
GROUNDWATER PATHWAY

The surface rocks at the Ray Wichert Property, in descending stratigraphic order, consist of Quaternary terrace deposits of sand, silt, clay, and gravel; the Permian Cloud Chief Formation of reddish-brown shale, siltstone, and sandstone; and the Permian Rush Springs Formation of orange-brown, fine-grained sandstone. The total thickness of these formations may be approximately 400 feet in the Clinton area (Reference **8**, sheet 1). Red sandstone bedrock is exposed on the floor of the basin within the Ray Wichert Property, which suggests that the overlying terrace deposits have been removed from the basin (Reference **4**). Terrace deposits and the Rush Springs Formation serve as the principal aquifers in the Clinton area. The terrace deposits may be up to 120 feet thick, while the Rush Springs Formation is approximately 186 feet thick in the Clinton area. Water from the Rush Springs Formation in the Clinton area is very hard, containing calcium, magnesium, and sulfate, as well as more than 1000 mg/l of dissolved solids (Reference **8**, sheets 1, 2, and 3).

Municipal and rural water systems supply drinking water to almost all residents within four miles of the Ray Wichert Property. Clinton Lake and Foss Lake are the sources of drinking water for the towns of Clinton and Arapaho (Reference **18**). These lakes are located twelve to fourteen miles west of the Ray Wichert Property (References **11** and **12**). Custer County Rural Water District 3 (RWD3) supplies drinking water to almost all rural residents within four miles of the site. RWD3 obtains its drinking water from three groundwater wells located approximately fifteen miles northeast of the site (References **11**, **13**, and **14**). No private drinking water wells were seen within one mile of the site (Reference **4**). Approximately 12 residences, located at least two miles south of the site in Washita County, lie outside both RWD3 and the City of Clinton municipal water system (References **11**, **12**, **13**, and **14**). These twelve residences are presumed to have private drinking water wells, but these wells are not hydraulically downgradient from the site. These twelve residences have a resident population of approximately 30 persons (Reference **23**). Thus the secondary target population for the groundwater pathway is 30 persons. There is no primary target population for the groundwater pathway.

No groundwater samples were collected for this SI of the Ray Wichert Property.

ATTACHMENT C
SURFACE WATER PATHWAY

The waste piles and underground storage tanks on the Ray Wichert Property lie on level or gently sloping ground in a topographic basin immediately adjacent to the west bank of an intermittent stream (Reference **4**). The waste piles and USTs are completely exposed to the weather (Reference **4**) in an area that receives an annual average of 25 inches of precipitation (Reference **8**, sheet 4). The intermittent stream bordering the northern half of the site lies within the 100-year floodplain, but the waste piles and USTs lie outside this floodplain (Reference **5**). Surface water runoff from the site enters the intermittent stream and flows northward, then eastward toward the Washita River, which is the nearest perennial water body. The site is more than two miles upstream from the Washita River. Thus there is no 15-mile surface water pathway for this site.

The site constitutes a drainage area of approximately 5.9 acres. Analyses of soil samples collected by OES personnel during this SI suggest that insecticides and polynuclear aromatic hydrocarbons might be entering the site from alternate sources around the site margins (**Tables 2** and **3**).

There are no surface water receptors because there is no surface water pathway for this site. Clinton Lake and Foss Lake, which are the sources of drinking water for the towns of Clinton and Arapaho, are located upstream from the site (References **11**, **12**, and **18**). The nearest HRS-defined wetland is more than two miles downstream from the site, as is the nearest perennial water body (Reference **20**).

No surface water or sediment samples were collected for this SI of the Ray Wichert Property.

ATTACHMENT D
SOIL PATHWAY

Soils on the Ray Wichert Property are of the Woodward-Quinlan Association. These are shallow to deep, well drained, loamy soils over sandstone and which belong to hydrologic soil group B (References **1** and **16**). Sandstone bedrock is exposed at a few places within the topographic basin on the site (Reference **4**).

Approximately 25 people live in 10 homes that are located within 200 feet west and north of the site (References **4** and **23**). No one works on the site, but at least twelve or more active businesses are located within 200 feet of the site (Reference **4**). As many as 9 businesses are located along the eastern margin of the site; 2 businesses are located immediately south and southeast of the site; and several businesses are located near the northwestern corner of the site. The number of workers at these twelve or more businesses is unknown, but if the number of workers per business is assumed to be the same as the average number of residents per household in Custer County (Reference **23**), then the total number of workers within 200 feet of the site would be approximately 29 persons. There are no daycare facilities within 200 feet of the site, but a school of gymnastics (Olympic Gold Gymnastics) is located immediately adjacent to the northeastern corner of the site. There is unrestricted access to the site from the gymnastics school parking lot. The number of students attending this school of gymnastics is unknown, but numerous young children were seen taking classes at the school (Reference **4**). Although the SI sample data described at the end of this section document the presence of contamination in the soil on the Ray Wichert Property, such contamination is not known to extend onto the properties of the nearest residents, the nearest businesses, and the gymnastics school. Therefore, the nearest residents, workers, and gymnastics school students cannot be considered as targets for the site under hazard ranking system (HRS) guidelines (Reference **19**).

Approximately 1341 persons live within one mile of the site (Reference **32**). Although access to the site is unrestricted (Reference **4**), there is little evidence that people frequently enter the site. For example, buildings on the southern end of the site are not vandalized, fresh trash is not strewn around the buildings or on other parts of the property, recreational vehicle tracks are not present on the property, and the waste piles in the northern half of the site show little or no evidence that dumping is an ongoing process that is still occurring.

The site is in an urban area (Reference **4**). Thus there are no terrestrial sensitive environments on or within 200 feet of the site. Although there is a wetland immediately adjacent to the northeastern margin of the site, it probably does not meet the requirements (presence of emergent hydrophytic vegetation) for designation as an HRS-defined wetland (References **19**, page A-30, and **20**). None of the endangered or threatened species known to be present in Custer County are known to be present on the site (Reference **21**).

ATTACHMENT D
SOIL PATHWAY (Continued)

The SI sample data indicate that arsenic, cadmium, calcium, mercury, carbazole, thirteen polynuclear aromatic hydrocarbons (PAHs), and seven pesticides are present in the soil among the waste piles at concentrations significantly above background concentrations (see Attachment A, **Tables 1**, **2**, and **3**; and References **6** and **7**). Of these 25 contaminants, only arsenic and 6 PAHs are present at concentrations that exceed EPA Region 6 Human Health Medium-Specific Screening Levels (Reference **28**). The arsenic may be derived from natural sources, while the source of PAHs in the soil among the waste piles is unknown. The radioactivity of surface soil in the basin on site does not appear to exceed background levels (Reference **4**). There is no soil sample data for the nearby residences, businesses, and gymnastics school.

ATTACHMENT E
AIR PATHWAY

The underground storage tanks and waste piles on the Ray Wichert Property are fully exposed to the weather (Reference **4**). It is not known if the USTs still contain gasoline or diesel fuel, nor whether they are releasing volatile airborne contaminants to the atmosphere. The waste piles are not believed to be a source of volatile airborne contaminants. No air sampling was conducted by OES personnel during their SI activities at the site.

The nearest residents to the Ray Wichert Property live less than 200 feet west of the site (Reference **4**). There are approximately 59 residents within 0.25-mile of the site and an additional 9561 persons living within four miles of the site (References **4, 11, 12, 17, 22,** and **23**).

Wetlands are the only sensitive environments located within four miles of the site. There is an approximate total of at least 43 acres of HRS-defined wetlands within four miles of the site, with the nearest wetland being 0.83-mile southeast of the site (Reference **20**).

TABLE 1
INORGANIC CONTAMINANTS IN SURFACE SOIL AMONG WASTE PILES ON RAY WICHERT PROPERTY

ANALYTE	CONCENTRATIONS (mg/kg), with Sample Quantitation Limits in brackets [ ]					
	DUPLICATES		SAMPLE 3 (MFJK52)	SAMPLE 4 (MFJK53)	SAMPLE 5 (MFJK54)	BACK-GROUND SAMPLE 6 (MFJK55)
	SAMPLE 1 (MFJK50)	SAMPLE 2 (MFJK51)				
ARSENIC	3.2 UC	4.1 UC	2.6 UC	**4.7 J^** [2.5]	2.9 UC	3.4 UC [2.5]
CADMIUM	0.20 LUC	0.50 LUC	0.67 LJ^	0.22 LUC	**3.3** [1.1]	0.25 LUC [1.2]
CALCIUM	**78000 J** [1220]	27800 J	**88600 J** [1100]	26400 J	**56400 J** [1070]	18000 J [1250]
MERCURY	0.076 L	0.075 L	0.096 L	0.058 L	**0.18** [0.09]	0.064 L [0.10]

DATA FLAGS AND MEANINGS:

BOLD FACE	Concentration is equal to or greater than three times the background concentration of this same analyte; or concentration is equal to or greater than the detection limit (CRDL/SQL) when the background concentration of the same analyte is undetected (U) or below the sample quantitation limit (SQL).
L	Reported concentration is between the Instrument Detection Limit (IDL) and the Contract Required Detection Limit (CRDL).
J	The result is an estimate.
UC	Reported concentration should be used as a raised detection limit because of apparent blank contamination.
^	High bias. Actual concentration may be lower than the concentration reported.

TABLE 2
POLYNUCLEAR AROMATIC HYDROCARBON CONTAMINANTS IN SURFACE SOIL AMONG WASTE PILES ON RAY WICHERT PROPERTY

ANALYTE	CONCENTRATIONS (μg/kg), with Sample Quantitation Limits in brackets [ ]					
	DUPLICATES		SAMPLE 3 (FGG58)	SAMPLE 4 (FGG59)	SAMPLE 5 (FGG60)	BACK-GROUND SAMPLE 6 (FGG61)
	SAMPLE 1 (FGG56)	SAMPLE 2 (FGG57)				
ACENAPHTHENE	**2300 J^** [1900]	1800 LJv	1100 LJ	21 LJ	400 LJ	400 U
PHENANTHRENE	5400 J^	**22000 Jv** [9900]	**11000** [1900]	130 LJ	**4400** [1800]	40 LJ
ANTHRACENE	1700 J^	**5800 Jv** [2000]	**2600** [1900]	47 LJ	1000 LJ	400 U
FLUORANTHENE	**63000** [9700]	**39000** [9900]	**15000** [3800]	250 LJ	**7700** [1800]	79 LJ
PYRENE	**52000** [9700]	**29000** [9900]	**16000 J** [3800]	230 LJ	**6700** [1800]	67 LJ
BENZO (a) ANTHRACENE	** **32000** [9700]	** **19000** [9900]	* **7600** [1900]	120 LJ	* **3000** [1800]	34 LJ
CHRYSENE	**32000** [9700]	**20000** [9900]	**8500** [1900]	190 LJ	**3500** [1800]	54 LJ
BENZO (b) FLUORANTHENE	* 3500 J^	** **16000 Jv** [2000]	* **6800** [1900]	210 LJ	* **2900** [1800]	75 LJ
BENZO (k) FLUORANTHENE	* **15000** [9700]	8600 LJ	* **7900** [1900]	180 LJ	**3500** [1800]	400 U
BENZO (a) PYRENE	** **26000** [9700]	** **16000** [2000]	** **7600** [1900]	160 LJ	** **3200** [1800]	37 LJ
INDENO (1,2,3-cd) PYRENE	** **13000** [1900]	** **8300** [2000]	* **4000** [1900]	100 LJ	* **1800** [1800]	26 LJ
DIBENZO (a,h) ANTHRACENE	** **6900** [1900]	** **3600** [2000]	** **1900** [1900]	40 LJ	740 LJ	400 U
BENZO (g,h,i) PERYLENE	**13000** [1900]	**8200** [2000]	**4400** [1900]	110 LJ	**2100** [1800]	29 LJ
CARBAZOLE ‡	980 J^	**2200 Jv** [2000]	1700 LJ	31 LJ	710 LJ	400 U

TABLE 2 (Continued)
POLYNUCLEAR AROMATIC HYDROCARBON CONTAMINANTS IN SURFACE SOIL AMONG WASTE PILES ON RAY WICHERT PROPERTY

DATA FLAGS AND MEANINGS:

BOLD FACE	Concentration is equal to or greater than three times the background concentration of this same analyte; or concentration is equal to or greater than the detection limit (CRQL or SQL) when the background concentration of the same analyte is undetected (U) or below the sample quantitation limit (SQL).

L	Reported concentration is below the Contract Required Quantitation Limit (CRQL).
J	Estimated value.
U	Not detected at reported quantitation limit.
^	High bias. Actual concentration may be lower than the concentration reported. Concentration shown in table has been corrected for high bias in accordance with EPA guidance for interpretation of Contract Laboratory Program data.
v	Low bias. Actual concentration may be higher than the concentration reported.
*	Concentration exceeds EPA's Region 6 residential risk-based screening level for this analyte in soil (Reference **19**).
**	Concentration exceeds both the EPA's Region 6 residential risk-based screening level and industrial risk-based screening level for this analyte in soil (Reference **19**).
‡	Carbazole is not a polynuclear aromatic hydrocarbon (PAH), but is included in this table because, like the PAHs, it is a semivolatile organic compound.

TABLE 3
PESTICIDE CONTAMINANTS IN SURFACE SOIL AMONG WASTE PILES ON RAY WICHERT PROPERTY

ANALYTE	CONCENTRATIONS (µg/kg), with Sample Quantitation Limits in brackets [ ]					
	DUPLICATES		SAMPLE 3 (FGG58)	SAMPLE 4 (FGG59)	SAMPLE 5 (FGG60)	BACK-GROUND SAMPLE 6 (FGG61)
	SAMPLE 1 (FGG56)	SAMPLE 2 (FGG57)				
DIELDRIN	2.1 LJ	4.1 U	**5.4** [3.8]	0.83 LJ	3.6 U	4.2 U
ENDRIN	**4.7 J** [3.9]	4.1 U	3.8 U	3.2 LJ	**4.8 J** [3.6]	1.0 LJ
ENDOSULFAN II	**4.0 J** [3.9]	4.1 U	3.8 U	0.58 LJ	3.6 U	0.94 LJ
4,4'-DDD	**6.6 J** [3.9]	4.1 U	3.8 U	0.95 LJ	3.6 U	4.2 U
4,4'-DDT	24 J^	**29 Jv** [4.1]	3.8 U	**13** [1.3]	3.6 UJv	4.2 U
ENDRIN KETONE	**14** [3.9]	**16** [4.1]	3.8 U	4.2 U	3.6 U	4.2 U
ALPHA-CHLORDANE	1.1 J^	**3.1 Jv** [2.1]	2.0 U	2.2 U	1.9 U	0.84 LJ

DATA FLAGS AND MEANINGS:

BOLD FACE	Concentration is equal to or greater than three times the background concentration of this same analyte; or concentration is equal to or greater than the detection limit (CRQL or SQL) when the background concentration of the same analyte is undetected (U) or below the sample quantitation limit (SQL).

L — Reported concentration is below the Contract Required Quantitation Limit (CRQL).

J — Estimated value.

U — Not detected at reported quantitation limit.

^ — High bias. Actual concentration may be lower than the concentration reported. Concentration shown in table has been corrected for high bias in accordance with EPA guidance for interpretation of Contract Laboratory Program data.

v — Low bias. Actual concentration may be higher than the concentration reported.

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REFERENCES FOR RAY WICHERT PROPERTY SI PRE-SCORE PACKAGE

28. U. S. Environmental Protection Agency, Region 6, Human Health Medium-Specific Screening Levels for contaminants in soil and other environmental media, July 12, 1999, including EPA and Nuclear Regulatory Commission risk-based screening levels for radionuclides in soil (from EPA/NRC Memorandum of Understanding).

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REFERENCE 1

12-14-90
Vol. 55 No. 241

federal register

Friday
December 14, 1990

Book 2

HRS Rules

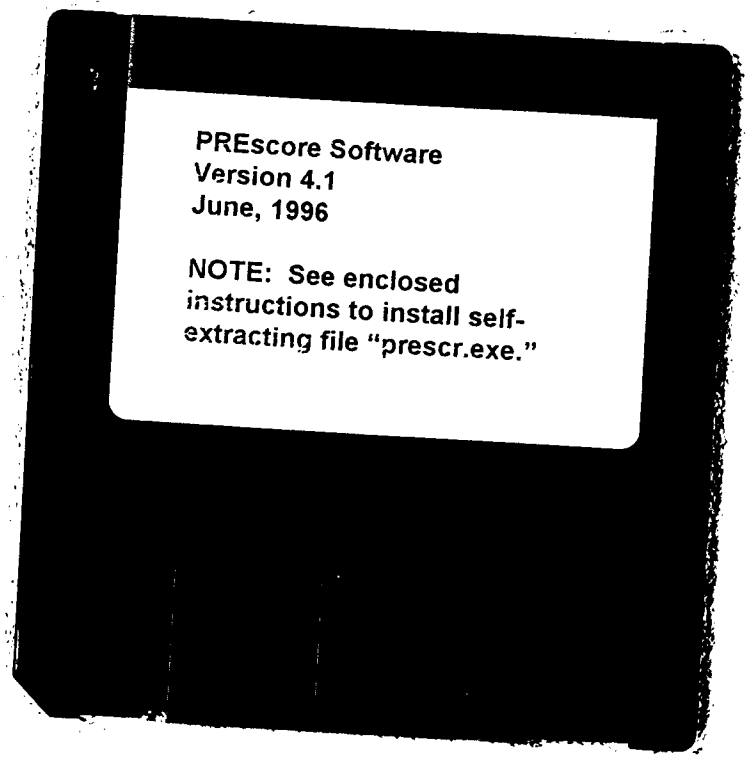
United States
Government
Printing Office
SUPERINTENDENT
OF DOCUMENTS
Washington, DC 20402

OFFICIAL BUSINESS
Penalty for private use, $300

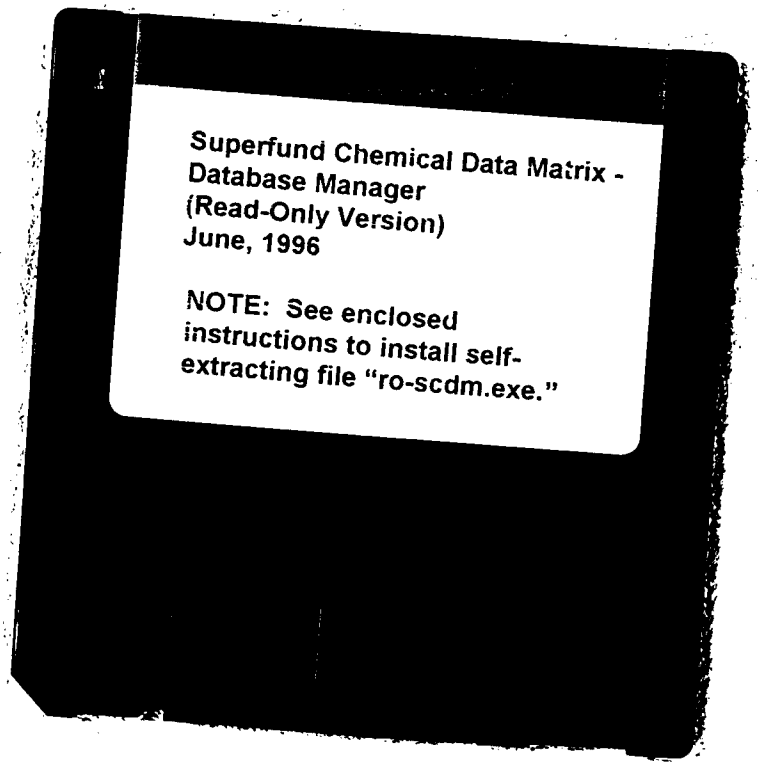
SECOND CLASS NEWSPAPER

Postage and Fees Paid
U.S. Government Printing Office
(ISSN 0097-6326)

REFERENCE 2


PREscore Software
Version 4.1
June, 1996
NOTE: See enclosed
instructions to install self-
extracting file "prescr.exe."

REFERENCE 3


Superfund Chemical Data Matrix -
Database Manager
(Read-Only Version)
June, 1996
NOTE: See enclosed
instructions to install self-
extracting file "ro-scdm.exe."

REFERENCE 4

"Rite in the Rain®"

ALL-WEATHER WRITING PAPER

FIELD

All-Weather Notebook

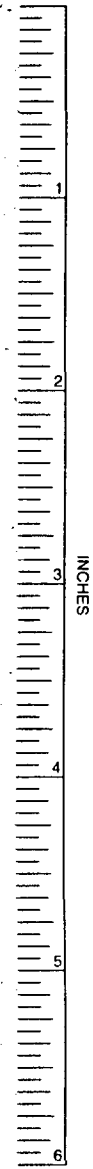
No. 351

Ray Wichert Property

Logbook #1

4 5/8" x 7" - 48 Numbered Pages

"Rite in the Rain"®
ALL-WEATHER WRITING PAPER



Name _____

_____

Address _____

_____

Phone _____

Project _____

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CONTENTS

Ray Wichert Property 4-27-00

Jason White collected ~~trip~~ trip blank #10 as follows:

FGGGS VOA's - 8:20

Samples were collected in parking lot of Best Western Hotel in Clinton, Ok. Jason White and Travis Waldo are taking initial rinsate sample #7 as follows:

FGG62 VOA's - 9:10
BNA - 9:11
Pest - 9:12
TM - 9:12
Cy - 9:12

Melinda Sims collected background soil sample #6 as follows:

VOA's 9:39
BNA/Pest - 9:41
TM/Cy - 9:42

Brad Cahill

Ray Wichert Property 4-27-00

Melinda Sims collected soil sample #4 as follows:

VOA's - 10:03
BNA/Pest - 10:04
TM/Cy - 10:05

Soil is medium brown in color, no odor present. Soil is fine & loamy with some clay present.

Melinda Sims collected soil sample #5 as follows:

VOA's - 10:10
BNA/Pest - 10:11
TM/Cy - 10:11

Soil is medium brown in color, no odor, and fine-grained & loamy. Some clay is present in soil.

Travis Waldo collected Final Rinsate QA/QC sample #8 as follows:

VOA's - 10:23 Pest - 10:24
BNA - 10:25 TM - 10:25 Cy - 10:25

Brad Cahill

Kent Curtis and Paul Choudhury of Cherokee Nation Office of Environmental Services (OES) visited the Ray Wichert Property from 1230 hrs. to 1415 hrs. with Damon Danbar, Ladonna TallBear, and Calvin Underwood of Cheyenne Arapaho Tribe (Damon, Ladonna) and Indian Health Service [Clinton office] (Calvin). They conducted a reconnaissance of the entire site and observed the following:

(1) The Ray Wichert Property is currently abandoned and unoccupied

(2) Access to the site is unrestricted, there being no fences on the west, south, and east sides of the property; a fence is located along the extreme northern end of the property

(3) The site is rectangular in shape, being approximately 200 ft. wide (east to west)

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and approximately 1600 ft. (0.3 mile) long (north to south), and approximately 320,000 sq. ft. in area

(4) the site is bordered on the west by a railroad; ~~and, imm~~ old U.S. highway 66 lies immediately west of this railroad.

The site is bordered on the north by livestock pens and a pasture in which cattle were grazing (photo looking N-NE by Kent Curtis); a private residence stands adjacent to the ~~e~~ livestock pens & pasture approximately 200 feet to 250 ft. north of the fence along the north margin of the site.

The site is bordered on the east and south by active industrial facilities, with at least 8 such facilities located immediately adjacent to the

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east margin of the site, and with one such facility located across Industrial Boulevard on the south margin of the site.

Industrial Blvd. is a two-lane street that forms the southern border of the site

14th Street runs parallel to the eastern margin of the site, with active businesses lining both sides of it, including the 8 facilities that are immediately adjacent to the east margin of the site.

the street (RE)

(5) An intermittent stream forms the entire eastern margin of the site. No water was seen in this stream today (Photo by Kent Curtis, looking south). Water in this intermittent stream flows northward.

(6) Topography of the site:

The southern portion of the site — an area approximately

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200 ft. x 250 ft. in size — is high, level ground.

The railroad embankment on the western margin of the site is also high ground.

Most of the site is a fairly level basin, with the railroad embankment sloping down into it on the west, and with the southern end of the basin rising steeply to the high, level ground on the south end of the site.

The eastern margin of the basin drops steeply into the intermittent stream bed.

The northern margin of the basin rises gently to the pasture that borders the northern end of the site.

(7) Vegetation on the site:

Vegetation is thickest on the eastern and western margins of the site, where trees line the railroad embankment and where

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forest lines the intermittent stream banks.
Grass, brush, and patches of bare ground fill the basin of the site.
The high, level ground on the southern end of the site is unvegetated, consisting of concrete and gravel.
Vegetation on the site appears to be normal—unstressed—except for some dead trees along the railroad embankment.

(8) Wildlife on site:
A live rabbit was seen on site.
A dead rabbit was lying next to one of the USTs on site.

(9) The surface rock on the site is a reddish sandstone, and the soil is a reddish-brown, sandy loam.

(10) Buildings on site:
Two ~~a~~ vacant buildings are located on the high, level ground

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at the southern end of the site.
The southernmost building is a large building that appears to contain offices and warehouse or garage space; large doors, capable of admitting trucks, are present on the building, and a grease trap is present in the concrete pad outside the large door on the north side of the building; a sign on the south side of this building says that the property is for sale by the Oklahoma Bank and Trust Company of Clinton, Okla.
The northernmost of the two buildings is a car wash, with a roof and open stalls.
A fuel dispenser island is located on a concrete pad between the car wash stalls and the southernmost building.
Three dispensers had been present on this island, but these

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motor fuel dispensers have been removed.
Kent and Paul did not see vents or filler ports for underground storage tanks on the concrete pad or among the gravel that covers the ground around the dispenser island and the two buildings. It appears that the USTs have been removed from the ground. Rust-colored scars on the concrete pad around the dispenser island (photo by Kent, looking NW) suggest that the USTs were dragged across it when they were removed from the ground.
Photos by Kent Curtis (looking south, SW, NW, and north) show the two buildings and the motor fuel dispenser island.

(11) Wastes lying on ground surface of site:
No stains of petroleum hydrocarbons

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were seen on the concrete pad or gravel around the buildings or fuel dispenser island, but oily liquid was present in the grease trap on the north side of the southernmost building.
Four underground storage tanks (USTs), ~~and three~~ the piping for those tanks, and three fuel dispensers were seen lying in the southern end of the basin on site, just north of the two buildings at the southern end of the site. It appears that the USTs, UST piping, and fuel dispensers removed from the southern end of the site were dumped on the ground in the basin on the site rather than being disposed of properly.
Three of the USTs are large, being approximately 6 ft. in diameter by 20 ft. in length; the fourth UST is smaller —

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perhaps half the size of the other three USTs. All four USTs are completely rusted, and no labels, engravings, or other markings are visible on them to identify their age, construction, contents, or ownership. At least half of the openings for piping on each UST are open, while the other half of the openings are plugged. Small holes are present on each UST — usually at seams on the ends of the tanks — showing that corrosion has eaten completely through each tank, but it could not be determined if the corrosion opened these holes while the tanks were still in the ground. There was no odor of petroleum hydrocarbons around the tanks, and no hydrocarbon stains were seen on the soil around the tanks. No attempt

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was made to determine if petroleum hydrocarbons were still present in these tanks, either in liquid or vapor form. The underground piping for these tanks was lying on the ground, immediately north of the four USTs. Photos by Kent Curtis (looking in all directions) show these USTs and their piping.

Three fuel dispensers were lying on the ground surface, just south of the four USTs (photo by Kent Curtis, looking north). Metal poles and signs, including two Texaco signs, were lying on the ground near the fuel dispensers and USTs (photo by Kent Curtis, looking NW).

(12) Wastes lying on ground surface of site (continued):

A dilapidated fence divides the ~~basi~~ topographic basin of the site

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into north and south halves. Most of the solid waste lying on the ground surface of the site is located in the north half of the topographic basin (north half of site). These solid wastes consist of scattered waste piles that consist almost entirely of construction debris (bricks, concrete, asphalt, and minor amounts of scrap lumber and scrap metal); traces of linoleum on flat slabs of concrete are the remains of interior floors of a building; one slab of concrete bears the date "10-17-27"; shingles indicate fragments of roof; fragments of brick walls, concrete floors, and cinder block foundations are abundant.
Only a few buckets and other containers are present among the waste piles; one container appeared to have been for

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Several old hot water heaters, and possibly a few small oil field separator vessels, were also present among the waste piles KC 5/1/03

lubricating oil.
Some of these solid wastes are lying in the bed of the intermittent stream on the eastern margin of the site. (Photos by Kent, looking S and E.)
There were no stains on the soil around these solid waste piles.
The approximate surface area covered by these numerous scattered waste piles was not estimated.
Photos by Kent Curtis (looking in various directions) show these waste piles.

(13) Radioactive screening survey of site:
Kent Curtis used a Ludlum Model 3A Survey Meter with a Ludlum model 44-9 pancake-type gamma ray detector to screen the surface soil and solid waste piles in the topographic basin of the site for radioactivity.

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Background radiation in the basin ranged from 10 μR/hr to 60 μR/hr (microroentgens per hour). The radioactivity of all surface soil surveyed in the basin ranged from 10 μR/hr to approximately 50 μR/hr. The radioactivity of almost all solid waste (construction debris, scrap metal, scrap lumber, linoleum, asphalt, concrete, brick) surveyed in the basin ranged from 10 μR/hr to 60 μR/hr. Only one waste pile near the center of the northern half of the topographic basin was found to contain debris with radioactivity exceeding the maximum background level of 60 μR/hr; two small slabs of concrete debris in this waste pile were found to have a radioactivity of up to 600 μR/hr (maximum), which is ten times the maximum back-

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ground level on site. These high levels of radioactivity suggest that the construction debris in this waste pile may have come from the Sooner Dial site in Clinton, Oklahoma.

(14) Human, tribal, & other targets in vicinity of Ray Wichert Property:

Nearest residents to site:

9 occupied homes lie on the west side of old U.S. highway 66, immediately west, and within 200 ft. to 250 ft. of the site; another occupied home stands within 250 ft. of the northern margin of the site; none of these 10 residences appears to have a private drinking water well, as determined from a windshield survey.

Schools and daycares:

No schools or daycare facilities were seen within 200 ft. of

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the site. However, a school of gymnastics — Olympic Gold Gymnastics — was located at 1391 South 14th Street (at the northern end of 14th Street), approximately 250 ft. from the northeastern corner of the site. The parking lot of Olympic Gold Gymnastics is immediately adjacent to the northeastern corner of the site, and a jeep trail leads into the northern end of the site from this parking lot. [Numerous young children were seen taking gymnastics classes inside the Olympic Gold Gymnastics building after 1700 hrs. today.]

Workers on or near site:

The Ray Wichert Property is currently unoccupied, so there are no workers on the site itself. However, there are

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numerous active businesses on all sides of the site: 9 businesses are located immediately adjacent to the east margin of the site; 2 businesses are located immediately south and SE of the site; several businesses are located on the west side of old U.S. highway 66, within 200 ft. to 250 ft. of the northwestern corner of the site; and a Howard Johnson's Motor Lodge is located approximately 400 ft. north of the site. The number of workers — and motel guests — at these businesses is unknown.

Tribal targets:

Four Indian homes are located just east of John Old Crow Cemetery, just under one mile east of the Ray Wichert Property; these homes are occupied but do not

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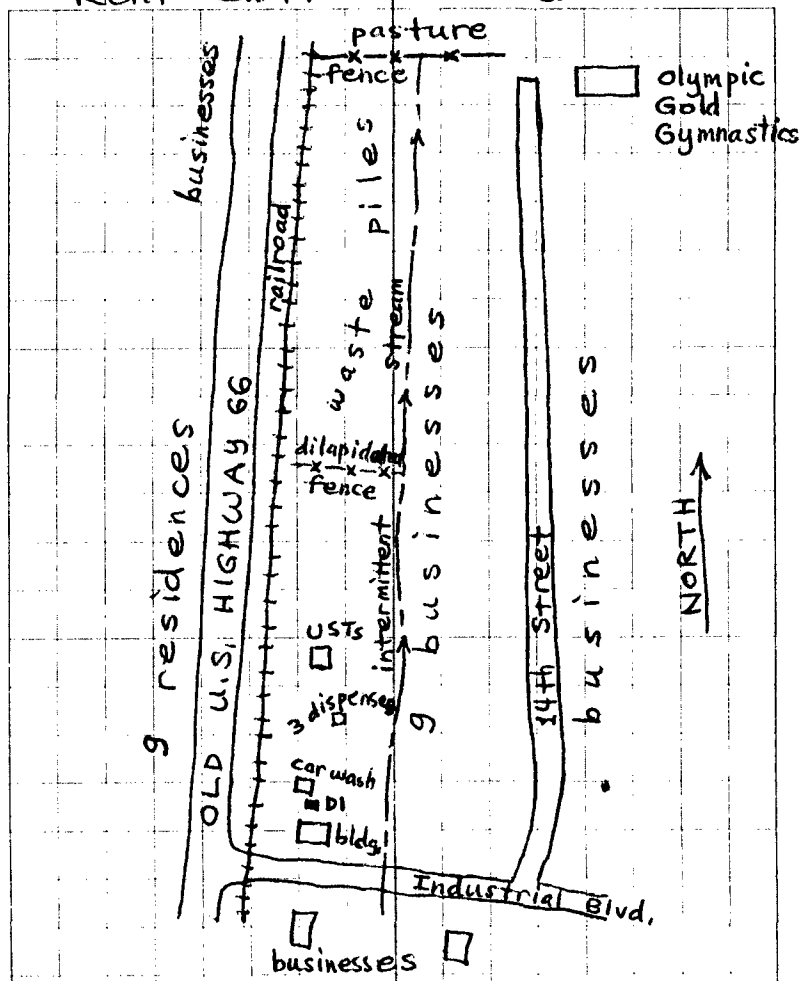
Ray Wichert Property
Kent Curtis 1 May, 2003

appear to have private wells. A water tower is located less than 0.5-mile southeast of the site, but a wellhead does not appear to be located at the tower.

While conducting reconnaissance of the Ray Wichert Property today, Ladonna Tall Bear (Cheyenne Arapaho Tribe) used a handheld Global Positioning System (GPS) unit to map the perimeter and other features of the site. She will provide the GPS coordinates of the site to the OES.

Kent Curtis 5/1/03



SKETCH OF RAY WICHERT PROPERTY AND IMMEDIATE SURROUNDINGS
(Not to scale)

■ DI = fuel dispenser island

Kent Curtis 5/1/03

Ray Wichert Property
Kent Curtis 2 May, 2003

Kent Curtis and Paul Choudhury of OES checked property records in the Custer County Courthouse in Arapaho and found the following:

The site that is referred to as the "Ray Wichert Property" actually consists of 3 parcels of land. The southernmost parcel is approximately 2 acres in size, being 160 ft. (east-west) by 541 ft. (north-south) in dimensions. This southernmost parcel was acquired from Earl G. Smith on Jan. 30, 1980 by Ervin Wichert, and Ray Wichert subsequently acquired the parcel from Ervin Wichert.

The central parcel of land is approximately 0.88 acre in size (approx. 160 ft. x 231 ft.) and was acquired from Earl G. Smith on Jan. 5, 1981 by Ray Wichert. Oklahoma Bank and Trust Co. is the current owner of ~~th~~ both

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Ray Wichert Property
Kent Curtis 2 May, 2003

the southernmost and central parcels of land, and the USTs, piping, and dispensers lie on these parcels of ~~the~~ land.

The northernmost parcel of land, on which the waste piles are located, is approximately (5?) acres in size and is currently owned, as it appears to have been since at least 1980, by Earl Glen Smith. The dilapidated fence seen on the property appears to mark the boundary between the northernmost and central parcels of land.

Northernmost parcel is probably 2 to 3 acres in size, as total area of northernmost, central, & southernmost parcels combined is approximately 5 to 6 acres. (KC)

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5/2/03

REFERENCE 5

REFERENCE 6

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION 6
HOUSTON BRANCH
10625 FALLSTONE RD.
HOUSTON, TEXAS 77099

MEMORANDUM

Date: June 16, 2000

Subject: Contract Laboratory Program Data Review

From: Marvelyn Humphrey, Alternate ESAT RPO, 6MD-HC

To: J. Enders, 6SF-RA

Site : RAY WICHERT PROPERTY

Case#: 28007

SDG# : MFJK50

The EPA Region 6 Houston Branch ESAT data review team has completed a review of the submitted Contract Laboratory Program (CLP) data package for the referenced site. The samples analyzed and reviewed are detailed in the attached Regional data review report.

The data package is acceptable for regional use. Problems, if any, are listed in the report narrative.

If you have any questions regarding the data review report, please call me at (281) 983-2140.

Attachments
cc: R. Flores, Region 6 CLP/TPO
M. El-Feky, Region 6 Data Coordinator
Files (2)

LOCKHEED MARTIN SERVICES GROUP
ESAT REGION VI
10101 SOUTHWEST FREEWAY, SUITE 500
HOUSTON, TEXAS 77074

MEMORANDUM

DATE: June 14, 2000

TO: Melvin Ritter/Marvelyn Humphrey, ESAT RPO/Alternate RPO, Region VI

FROM: Tom Chiang, ESAT Team Manager, Region VI

SUBJECT: CLP Data Review

REF: TDF #6-0376A ESAT File No. I2429
ESAT Contract No. 68-D6-0005

Attached is the data review summary for Case # 28007
SDG # MFJK50
Site Ray Wichert Property

COMMENTS:

I. CONTRACTUAL ASSESSMENT OF DATA PACKAGE:

Hard copy review could not confirm the noncompliant items noted by CCS but detected the following contractually noncompliant item.

The laboratory analyzed the continuing calibration verification (CCV) standards for antimony at the same concentration as the initial calibration verification (ICV) standard. The SOW requires the analyte concentrations in the CCV to be different than the concentration used for the ICV (ILM04.0, Exhibit E, E-17, b). The sample results were not technically affected because other QC analyses such as the ICSAB with different concentrations from the ICV provided the missing QC information.

II. TECHNICAL/USABILITY ASSESSMENT OF DATA PACKAGE:

A total of 144 results were reviewed for this data package. Some results have been qualified because of technical problems. The significant problems are addressed below.

A. Blank concentrations affected some arsenic, beryllium, cadmium, selenium, and thallium results.

B. The antimony and selenium matrix spike recoveries were below the QC limits.

C. Replicate instrument readings were inconsistent for one selenium analysis.

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION 6
HOUSTON BRANCH
10625 FALLSTONE ROAD
HOUSTON, TEXAS 77099

INORGANIC REGIONAL DATA ASSESSMENT

CASE NO. 28007 SITE Ray Wichert Property
LABORATORY LIBRTY NO. OF SAMPLES 6
CONTRACT# 68-W0-0082 MATRIX Soil
SDG# MFJK50 REVIEWER (IF NOT ESD) ESAT
SOW# ILM04.1 REVIEWER'S NAME L. Hoffman
ACCT# 050102DJN70 SF# 50102DZZ COMPLETION DATE June 14, 2000

SAMPLE NO.					
	MFJ-K50	MFJ-K54			
	MFJ-K51	MFJ-K55			
	MFJ-K52				
	MFJ-K53				

DATA ASSESSMENT SUMMARY

	ICP	HG	CYANIDE
1. HOLDING TIMES	O	O	O
2. CALIBRATIONS	O	O	O
3. BLANKS	M	O	O
4. MATRIX SPIKES	M	O	O
5. DUPLICATE ANALYSIS	M	O	O
6. ICP QC	M		
7. FAA QC			
8. LCS	O	O	O
9. SAMPLE VERIFICATION	O	O	O
10. OTHER QC	M	O	O
11. OVERALL ASSESSMENT	M	O	O

O = Data had no problems.
M = Data qualified because of major or minor problems.
Z = Data unacceptable.
N/A= Not applicable

ACTION ITEMS:

AREAS OF CONCERN: The laboratory failed to analyze the antimony CCV's at contract-required concentrations. Laboratory blank concentrations affected some arsenic, beryllium, cadmium, selenium, and thallium results. The antimony and selenium matrix spike recoveries were below 75 percent. The calcium laboratory duplicate relative percent difference (RPD) was above 35 percent. The copper and potassium serial dilution differences were above 10 percent. One selenium analysis had a coefficient of variation greater than 20 percent. The calcium field duplicate RPD was greater than 80 percent.

NOTABLE PERFORMANCE: The laboratory submitted the data package four calendar days early.

COMMENTS/CLARIFICATIONS
REGION 6 CLP QA REVIEW

Case 28007 SDG MFJK50 Site Ray Wichert Property Lab LIBRTY

COMMENTS: The SDG consisted of six soil samples for total metals and cyanide analyses by ILM04.1. The sampler designated sample MFJ-K50 as the QC sample and the field duplicate of sample MFJ-K51. The laboratory met the 21-day data package turnaround time requirement. The reviewer noted the following contractually noncompliant item.

- The CCV concentrations for antimony were not contractually compliant.

Fifty-eight percent of the reported results were above the CRDL's. Some results were qualified because of problems with laboratory blank concentrations, matrix spike recoveries, laboratory and field duplicate differences, serial dilution differences, and replicate instrument readings. The technical usability of all reported results is indicated in the Data Summary Table (DST). An Evidence Audit was conducted for the Complete Sample Delivery Group File (CSF), and the results were recorded in the Evidence Inventory Checklist.

NOTE: THE FOLLOWING REVIEW NARRATIVE ADDRESSES BOTH CONTRACTUAL ISSUES (BASED ON THE STATEMENT OF WORK) AND TECHNICAL ISSUES (BASED ON THE NATIONAL FUNCTIONAL GUIDELINES). THE ASSESSMENT MADE FOR EACH QC PARAMETER IS SOLELY BASED ON THE TECHNICAL DATA USABILITY, WHICH MAY NOT NECESSARILY BE AFFECTED BY CONTRACTUAL PROBLEMS. THE ASSESSMENTS ARE DEFINED BELOW.

Acceptable = No results were qualified for any problems associated with this QC parameter.
Provisional = Some results were qualified because of problems associated with this QC parameter.
Unusable = All results are unusable because of major problems associated with this QC parameter.

1. **Holding Times:** Acceptable. All samples met contractual holding time criteria. Technical holding time criteria have not yet been established for soil samples. Sample preservation was acceptable.

2. **Calibrations:** Acceptable. All calibrations met contractual requirements. The CRDL standard recoveries indicated acceptable instrument performance near the CRDL's.

3. **Blanks:** Provisional. Preparation and calibration blanks met contractual requirements although the laboratory reported 18 analytes in the blanks. The reviewer qualified the arsenic result for sample MFJ-K53 as estimated and biased high and the following results as undetected because of laboratory blank concentrations:

   the arsenic results for all samples except MFJ-K53;

3. **Blanks, continued:**

   the beryllium results for samples MFJ-K50, MFJ-K52, and MFJ-K54;

   the cadmium results for samples MFJ-K50, MFJ-K51, MFJ-K53, and MFJ-K55; and

   all detected selenium and thallium results.

4. **Pre-digestion/Pre-distillation Matrix Spike Recovery:** Provisional. The reviewer qualified the antimony and selenium results as estimated and biased low because the associated matrix spike recoveries were below the QC limits.

5. **Duplicate Analysis:** Provisional. The reviewer qualified the calcium results as estimated because the calcium RPD was above the QC limit.

6. **ICP Quality Control:**

   Serial Dilution: Provisional. The laboratory reported outlying serial dilution differences for copper and potassium, so the reviewer qualified as estimated the copper and potassium results. The serial dilution results were lower than the undiluted results, indicating that matrix interferences enhanced the signals for these analytes. Therefore, the reviewer also qualified the copper and potassium results as high biased.

   Interference Check Sample (ICS): Acceptable. The reported ICS results indicated satisfactory interelement and background corrections.

   Coefficient of Variation: Provisional. The reviewer qualified as estimated the selenium result for sample MFJ-K53 because replicate instrument readings were inconsistent.

7. **Furnace Atomic Absorption Quality Control:** Not Applicable.

8. **Laboratory Control Sample (LCS):** Acceptable. The laboratory reported acceptable LCS recoveries, indicating satisfactory sample preparation and analysis.

9. **Sample Verification:** Acceptable. The reviewer detected a few reporting errors that did not affect sample results. The laboratory was contacted for corrections (see FAX Record Log).

Case 28007 SDG MFJK50 Site Ray Wichert Property Lab LIBRTY

10. **Other QC:**

Field Duplicates: Provisional. The reviewer qualified the calcium results as estimated because of inconsistent field duplicate results.

11. **Overall Assessment:** Sample result qualifications are summarized below.

The reviewer qualified six arsenic, three beryllium, four cadmium, four selenium, and two thallium results because of laboratory blank effects.

The reviewer qualified all antimony, copper, potassium, and selenium results because of matrix related problems.

The reviewer qualified the calcium results because of poor laboratory and field precision.

The reviewer qualified one selenium result because of inconsistent instrument readings.

INORGANIC DATA QUALIFIER DEFINITIONS

The following definitions provide brief explanations of the ESAT-Region 6 qualifiers assigned to results in the inorganic data review process.

U Undetected at the laboratory reported detection limit (IDL).

L Reported concentration is between the IDL and the CRDL.

J Result is estimated because of outlying quality control parameters such as matrix spike, serial dilution, FAA spike recovery, etc.

R Result is unusable.

F A possibility of a false negative exists.

UC Reported concentration should be used as a raised detection limit because of apparent blank contamination.

^ High bias. Actual concentration may be lower than the concentration reported.

v Low bias. Actual concentration may be higher than the concentration reported.

INORGANIC DATA SUMMARY

Case No. : 28007 SDG : MFJK50 Reviewer : L. Hoffman

Laboratory : LIBRTY Matrix : Soil Units : mg/Kg

EPA Sample #=>	FLAG MFJ-K50	FLAG MFJ-K51	FLAG MFJ-K52	FLAG MFJ-K53	FLAG MFJ-K54	FLAG MFJ-K55	FLAG
ALUMINUM	12100	13400	7300	16600	7940	13400	
ANTIMONY	0.51 U Jv	0.51 U Jv	4.2 LJv	0.53 U Jv	0.45 UJv	0.52 U Jv	
ARSENIC	3.2 UC	4.1 UC	2.6 UC	4.7 J^	2.9 UC	3.4 UC	
BARIUM	194	225	660	174	251	266	
BERYLLIUM	0.70 LUC	0.77 LJ^	0.49 LUC	0.97 LJ^	0.52 LUC	0.82 LJ^	
CADMIUM	0.20 LUC	0.50 LUC	0.67 LJ^	0.22 LUC	3.3	0.25 LUC	
CALCIUM	78000 J	27800 J	88600 J	26400 J	56400 J	18000 J	
CHROMIUM	12.9	14.6	12.1	16.2	13.2	15.9	
COBALT	5.0 L	5.7 L	3.5 L	6.5 L	3.6 L	6.0 L	
COPPER	11.4 J^	12.8 J^	8.4 J^	15.0 J^	9.8 J^	16.4 J^	
IRON	11200	12600	7050	15100	7790	13000	
LEAD	27.0	36.1	41.6	15.7	49.9	48.1	
MAGNESIUM	17900	19000	32100	19400	7750	16200	
MANGANESE	288	322	192	350	196	366	
MERCURY	0.076 L	0.075 L	0.096 L	0.058 L	0.18	0.064 L	
NICKEL	12.5	13.5	8.5 L	16.2	8.8	15.5	
POTASSIUM	2340 J^	2500 J^	1710 J^	2940 J^	1550 J^	3150 J^	
SELENIUM	0.75 LUCJv	0.77 LUCJv	0.48 U Jv	0.97 LUCJv	0.49 LUCJv	0.55 UJv	
SILVER	0.15 U	0.14 U	0.13 U	0.15 U	0.13 U	0.15 U	
SODIUM	238 LJv	169 LJv	180 LJv	144 LJv	129 LJv	150 LJv	
THALLIUM	0.80 LUC	0.78 U	0.70 U	0.97 LUC	0.68 U	0.80 U	
VANADIUM	20.9	23.5	14.2	28.2	15.6	22.6	
ZINC	70.0	134	69.1	89.8	106	80.4	
CYANIDE	0.080 L	0.066 L	0.072 L	0.081 L	0.051 U	0.14 L	
% Solids :	82.0	81.6	85.0	79.0	88.4	77.0	

INORGANIC DATA SUMMARY

Case No. : 28007 SDG : MFJK50 Reviewer : L. Hoffman

Laboratory : LIBRTY Matrix : Soil Units : mg/Kg

Dup. 1

background

#1 #2 #3 #4 #5 #6

EPA Sample #=>	FLAG MFJ-K50	FLAG MFJ-K51	FLAG MFJ-K52	FLAG MFJ-K53	FLAG MFJ-K54	FLAG MFJ-K55	FLAG
ALUMINUM	12100 48.8	13400 48.5	7300 44.0	16600 50.1	7940 42.7	13400 50.0	
ANTIMONY	0.51 U Jv 14.6	0.51 U Jv 14.6	4.2 LJv 13.2	0.53 U Jv 15.0	0.45 UJv 12.8	0.52 U Jv 15.0	
ARSENIC	3.2 UC 2.4	4.1 UC 2.4	2.6 UC 2.2	(4.7 J^) 2.5	2.9 UC 2.1	3.4 UC 2.5	
BARIUM	194 48.8	225 48.5	660 44.0	174 50.1	251 42.7	266 50.0	
BERYLLIUM	0.70 LUC 1.2	0.77 LJ^ 1.2	0.49 LUC 1.1	0.97 LJ^ 1.3	0.52 LUC 1.1	0.82 LJ^ 1.2	
CADMIUM	0.20 LUC 1.2	0.50 LUC 1.2	0.67 LJ^ 1.1	0.22 LUC 1.3	3.3 1.1	0.25 LUC 1.2	
CALCIUM	78000 J 1229	27800 J 1213	88600 J 1100	26400 J 1253	56400 J 1067	18000 J 1249	
CHROMIUM	12.9 2.4	14.6 2.4	12.1 2.2	16.2 2.5	13.2 2.1	15.9 2.5	
COBALT	5.0 L 12.2	5.7 L 12.1	3.5 L 11.0	6.5 L 12.5	3.6 L 10.7	6.0 L 12.5	
COPPER	11.4 J^ 6.1	12.8 J^ 6.1	8.4 J^ 5.5	15.0 J^ 6.3	9.8 J^ 5.3	16.4 J^ 6.2	
IRON	11200 24.4	12600 24.3	7050 22.0	15100 25.1	7790 21.3	13000 25.0	
LEAD	27.0 0.73	36.1 0.73	41.6 0.66	15.7 0.75	49.9 0.64	48.1 0.75	
MAGNESIUM	17900 1220	19000 1213	32100 1100	19400 1253	7750 1067	16200 1249	
MANGANESE	288 3.7	322 3.6	192 3.3	350 3.8	196 3.2	366 3.7	
MERCURY	0.076 L 0.12	0.075 L 0.11	0.096 L 0.12	0.058 L 0.11	0.18 0.09	0.064 L 0.10	
NICKEL	12.5 9.8	13.5 9.7	8.5 L 8.8	16.2 10.0	8.8 8.5	15.5 10.0	
POTASSIUM	2340 J^ 1220	2500 J^ 1213	1710 J^ 1100	2940 J^ 1253	1550 J^ 1067	3150 J^ 1249	
SELENIUM	0.75 LUCJv 1.2	0.77 LUCJv 1.2	0.48 U Jv 1.1	0.97 LUCJv 1.3	0.49 LUCJv 1.1	0.55 UJv 1.2	
SILVER	0.15 U 2.4	0.14 U 2.4	0.13 U 2.2	0.15 U 2.5	0.13 U 2.1	0.15 U 2.5	
SODIUM	238 LJv 1220	169 LJv 1213	180 LJv 1100	144 LJv 1253	129 LJv 1067	150 LJv 1249	
THALLIUM	0.80 LUC 2.4	0.78 U 2.4	0.70 U 2.2	0.97 LUC 2.5	0.68 U 2.1	0.80 U 2.5	
VANADIUM	20.9 12.2	23.5 12.1	14.2 11.0	28.2 12.5	15.6 10.7	22.6 12.5	
ZINC	70.0 4.9	134 4.9	69.1 4.4	89.8 5.0	106 4.3	80.4 5.0	
CYANIDE	0.080 L 0.61	0.066 L 0.61	0.072 L 0.59	0.081 L 0.63	0.051 U 0.57	0.14 L 0.65	
% Solids :	82.0	81.6	85.0	79.0	88.4	77.0	

P	1.0	1.01	1.07	1.01	1.06	1.04
CV	0.20	0.22	0.20	0.24	0.26	0.27
CA	1.0	1.0	1.0	1.0	1.0	1.0

~~arsenic less than action level of 50 mg/kg, but~~ arsenic exceeds residential & industrial cancer risk

no other hits (Cd, Ca, Hg) exceed EPA6 Human Health Medium-Specific Screening Levels

INORGANIC/ORGANIC COMPLETE SDG FILE (CSF) INVENTORY CHECKLIST

Case No. 28007 SDG No. MFJK50 SDG Nos. To Follow _____ SAS No. _____ Date Rec 05/15/00

EPA Lab ID: LIBRTY

Lab Location: Cary, NC

Region: 6 Audit No.: 28007/MFJK50

Re_Submitted CSF? Yes _____ No X

Box No(s): 1

COMMENTS:

4. The laboratory did not record the sample tags on Form DC-2 and was notified about this omission.

Over for additional comments.

ORIGINALS	YES	NO	N/A
CUSTODY SEALS			
1. Present on package?	X		
2. Intact upon receipt?	X		
FORM DC-2			
3. Numbering scheme accurate?	X		
4. Are enclosed documents listed?		X	
5. Are listed documents enclosed?	X		
FORM DC-1			
6. Present?	X		
7. Complete?	X		
8. Accurate?	X		
CHAIN-OF-CUSTODY RECORD(s)			
9. Signed?	X		
10. Dated?	X		
TRAFFIC REPORT(s) PACKING LIST(s)			
11. Signed?	X		
12. Dated?	X		
AIRBILLS/AIRBILL STICKER			
13. Present?	X		
14. Signed?			X
15. Dated?			X
SAMPLE TAGS			
16. Does DC-1 list tags as being included?	X		
17. Present?	X		
OTHER DOCUMENTS			
18. Complete?	X		
19. Legible?	X		
20. Original?		X	
20a. If "NO", does the copy indicate where original documents are located?	X		

Audited by: _____ Linda Hoffman / ESAT Data Reviewer Date 06/13/00

Audited by: _____ _____ Date _____

Audited by: _____ _____ Date _____

Signature Printed Name/Title

TO BE COMPLETED BY CEAT

Date Recvd by CEAT: _____ Date Entered: _____ Date Reviewed: _____

Entered by: _____ _____

Reviewed by: _____ _____

Signature Printed Name/Title

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION 6
HOUSTON BRANCH
10625 FALLSTONE RD.
HOUSTON, TEXAS 77099

MEMORANDUM

Date: June 16, 2000

Subject: Contract Laboratory Program Data Review

From: Marvelyn Humphrey, Alternate ESAT RPO, 6MD-HC

To: J. Enders, 6SF-RA

Site : RAY WICHERT PROPERTY

Case#: 28007

SDG# : MFJK56

The EPA Region 6 Houston Branch ESAT data review team has completed a review of the submitted Contract Laboratory Program (CLP) data package for the referenced site. The samples analyzed and reviewed are detailed in the attached Regional data review report.

The data package is acceptable for regional use. Problems, if any, are listed in the report narrative.

If you have any questions regarding the data review report, please call me at (281) 983-2140.

Attachments
cc: R. Flores, Region 6 CLP/TPO
M. El-Feky, Region 6 Data Coordinator
Files (2)

LOCKHEED MARTIN SERVICES GROUP
ESAT REGION VI
10101 SOUTHWEST FREEWAY, SUITE 500
HOUSTON, TEXAS 77074

MEMORANDUM

DATE: June 13, 2000

TO: Melvin Ritter/Marvelyn Humphrey, ESAT RPO/Alternate RPO, Region VI

FROM: Tom Chiang, ESAT Team Manager, Region VI

SUBJECT: CLP Data Review

REF: TDF #6-0374A ESAT File No. I2430
ESAT Contract No. 68-D6-0005

Attached is the data review summary for Case # 28007
SDG # MFJK56
Site Ray Wichert Property

COMMENTS:

I. CONTRACTUAL ASSESSMENT OF DATA PACKAGE:

Hard copy review could not confirm the noncompliant items noted by CCS but detected the following contractually noncompliant item.

The laboratory analyzed the continuing calibration verification (CCV) standards for antimony at the same concentration as the initial calibration verification (ICV) standard. The SOW requires the analyte concentrations in the CCV to be different than the concentration used for the ICV (ILM04.0, Exhibit E, E-17, b). The sample results were not technically affected because other QC analyses such as the ICSAB with different concentrations from the ICV provided the missing QC information.

II. TECHNICAL/USABILITY ASSESSMENT OF DATA PACKAGE:

A total of 72 results were reviewed for this data package. Some results have been qualified because of technical problems. The significant problems are addressed below.

A. The mercury CRDL standard recovery was high.

B. Blank concentrations affected some antimony, arsenic, beryllium, cadmium, and thallium results.

C. Replicate instrument readings were inconsistent for one selenium analysis.

LOCKHEED MARTIN SERVICES GROUP
ESAT REGION VI
10101 SOUTHWEST FREEWAY, SUITE 500
HOUSTON, TEXAS 77074

MEMORANDUM, continued

Attached is the data review summary for Case # 28007
SDG # MFJK56
Site Ray Wichert Property

III. OTHER AREAS OF CONCERN:

The field blank was contaminated with concentrations above the CRDL's for calcium, potassium, and sodium.

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION 6
HOUSTON BRANCH
10625 FALLSTONE ROAD
HOUSTON, TEXAS 77099

INORGANIC REGIONAL DATA ASSESSMENT

CASE NO. 28007 SITE Ray Wichert Property
LABORATORY LIBRTY NO. OF SAMPLES 3
CONTRACT# 68-W0-0082 MATRIX Water
SDG# MFJK56 REVIEWER (IF NOT ESD) ESAT
SOW# ILM04.1 REVIEWER'S NAME L. Hoffman
ACCT# 050102DJN70 SF# 50102DZZ COMPLETION DATE June 13, 2000

SAMPLE NO.					
	MFJ-K56				
	MFJ-K57				
	MFJ-K58				

DATA ASSESSMENT SUMMARY

	ICP	HG	CYANIDE
1. HOLDING TIMES	O	O	O
2. CALIBRATIONS	O	M	O
3. BLANKS	M	O	O
4. MATRIX SPIKES	N/A	N/A	N/A
5. DUPLICATE ANALYSIS	N/A	N/A	N/A
6. ICP QC	M		
7. FAA QC			
8. LCS	O	N/A	O
9. SAMPLE VERIFICATION	O	O	O
10. OTHER QC	N/A	N/A	N/A
11. OVERALL ASSESSMENT	M	M	O

O = Data had no problems.
M = Data qualified because of major or minor problems.
Z = Data unacceptable.
N/A= Not applicable

ACTION ITEMS:

AREAS OF CONCERN: The laboratory failed to analyze the antimony CCV's at contract-required concentrations. The mercury CRDL standard recovery was 150 percent. Laboratory blank concentrations affected some aluminum, antimony, arsenic, beryllium, cadmium, thallium, vanadium, and zinc results. One selenium analysis had a coefficient of variation greater than 20 percent.

NOTABLE PERFORMANCE: The laboratory submitted the data package eight calendar days early.

COMMENTS/CLARIFICATIONS
REGION 6 CLP QA REVIEW

Case 28007 SDG MFJK56 Site Ray Wichert Property Lab LIBRTY

COMMENTS: The SDG consisted of two rinsates, samples MFJ-K56 and MFJ-K57, and a field blank, sample MFJ-K58, for total metals and cyanide analyses by ILM04.1. Since the samples in this SDG were field QC samples, QC analyses were not required. The laboratory met the 21-day data package turnaround time requirement. The reviewer noted the following contractually noncompliant item.

- The CCV concentrations for antimony were not contractually compliant.

Fourteen percent of the reported results were above the CRDL's. Some results were qualified because of problems with instrument performance near the CRDL, laboratory blank concentrations, and replicate instrument readings. The technical usability of all reported results is indicated in the Data Summary Table (DST). An Evidence Audit was conducted for the Complete Sample Delivery Group File (CSF), and the results were recorded in the Evidence Inventory Checklist.

NOTE: THE FOLLOWING REVIEW NARRATIVE ADDRESSES BOTH CONTRACTUAL ISSUES (BASED ON THE STATEMENT OF WORK) AND TECHNICAL ISSUES (BASED ON THE NATIONAL FUNCTIONAL GUIDELINES). THE ASSESSMENT MADE FOR EACH QC PARAMETER IS SOLELY BASED ON THE TECHNICAL DATA USABILITY, WHICH MAY NOT NECESSARILY BE AFFECTED BY CONTRACTUAL PROBLEMS. THE ASSESSMENTS ARE DEFINED BELOW.

Acceptable = No results were qualified for any problems associated with this QC parameter.

Provisional = Some results were qualified because of problems associated with this QC parameter.

Unusable = All results are unusable because of major problems associated with this QC parameter.

1. **Holding Times:** Acceptable. All samples met contractual and technical holding time criteria. Sample preservation was acceptable.

2. **Calibrations:** Provisional. All calibrations met contractual requirements. However, the laboratory reported a high mercury CRDL standard recovery (150%), which indicated poor instrument performance near the mercury CRDL. Therefore, the reviewer qualified the detected mercury result as estimated and biased high.

3. **Blanks:** Provisional. Preparation and calibration blanks met contractual requirements although the laboratory reported 17 analytes in the blanks. The reviewer qualified

3. **Blanks, continued:** zinc result for sample MFJ-K57 as estimated and biased low and the following results as undetected because of laboratory blank concentrations:

   all aluminum, beryllium, and cadmium results;

   the antimony and arsenic results for sample MFJ-K58;

   the thallium results for samples MFJ-K57 and MFJ-K58; and

   the vanadium result for sample MFJ-K57.

   Field Blank: The laboratory reported concentrations of aluminum, antimony, arsenic, beryllium, cadmium, magnesium, manganese, thallium, and vanadium below the CRDL's and calcium, potassium, and sodium above the CRDL's in the field blank sample. The aluminum, antimony, arsenic, beryllium, cadmium, and thallium concentrations were due to laboratory blank concentrations. Because the associated soil samples (SDG MFJK50) have different matrix and reporting units than the field blank (water), the reviewer can not accurately flag the soil sample results for field contamination.

   Rinsates: The laboratory reported concentrations of aluminum, antimony, barium, beryllium, cadmium, chromium, cobalt, iron, magnesium, manganese, mercury, nickel, selenium, thallium, vanadium, and/or zinc below the CRDL's and calcium, potassium, and sodium above the CRDL's in the rinsate samples. The zinc concentration in rinsate sample MFJ-K57 was above the CRDL. The aluminum, beryllium, cadmium, thallium, and vanadium concentrations were due to laboratory blank concentrations. Assessment for sampling equipment contamination can not be performed because information associating the samples with the rinsates is not available.

4. **Pre-digestion Matrix Spike Recovery:** Not Applicable.

5. **Duplicate Analysis:** Not Applicable.

6. **ICP Quality Control:**

   Serial Dilution: Not Applicable.

   Interference Check Sample (ICS): Acceptable. The reported ICS results indicated satisfactory interelement and background corrections.

Case 28007 SDG MFJK56 Site Ray Wichert Property Lab LIBRTY

6. **ICP Quality Control, continued:**

   Coefficient of Variation: Provisional. The reviewer qualified the selenium result for sample MFJ-K57 because replicate instrument readings were inconsistent.

7. **Furnace Atomic Absorption Quality Control:** Not Applicable.

8. **Laboratory Control Sample (LCS):** Acceptable. The laboratory reported acceptable LCS recoveries, indicating satisfactory sample preparation and analysis.

9. **Sample Verification:** Acceptable. The reviewer detected a few reporting errors that did not affected sample results. The laboratory was contacted for corrections (see FAX Record Log).

10. **Other QC:** Not Applicable.

11. **Overall Assessment:** Sample result qualifications are summarized below.

    The reviewer qualified one mercury result because of poor instrument performance near the CRDL.

    The reviewer qualified one antimony, one arsenic, three beryllium, three cadmium, one vanadium, one zinc, and two thallium results because of laboratory blank effects.

    The reviewer qualified one selenium result because of inconsistent instrument readings.

INORGANIC DATA QUALIFIER DEFINITIONS

The following definitions provide brief explanations of the ESAT-Region 6 qualifiers assigned to results in the inorganic data review process.

U Undetected at the laboratory reported detection limit (IDL).

L Reported concentration is between the IDL and the CRDL.

J Result is estimated because of outlying quality control parameters such as matrix spike, serial dilution, FAA spike recovery, etc.

R Result is unusable.

F A possibility of a false negative exists.

UC Reported concentration should be used as a raised detection limit because of apparent blank contamination.

^ High bias. Actual concentration may be lower than the concentration reported.

v Low bias. Actual concentration may be higher than the concentration reported.

INORGANIC DATA SUMMARY

Case No. : 28007 SDG : MFJK56 Reviewer : L. Hoffman

Laboratory : LIBRTY Matrix : Water Units : ug/L

EPA Sample #=>	MFJ-K56	FLAG	MFJ-K57	FLAG	MFJ-K58	FLAG		FLAG		FLAG		FLAG		FLAG
ALUMINUM	61.3	LUC	87.6	LUC	75.1	LUC								
ANTIMONY	2.1	U	2.2	L	5.3	LUC								
ARSENIC	2.3	U	2.3	U	4.1	LUC								
BARIUM	7.9	L	6.1	L	5.1	L								
BERYLLIUM	0.46	LUC	0.48	LUC	0.52	LUC								
CADMIUM	0.33	LUC	0.25	LUC	0.26	LUC								
CALCIUM	19400		20000		20100									
CHROMIUM	0.49	LJv	1.1	LJv	0.40	U								
COBALT	0.59	L	0.50	U	0.50	U								
COPPER	0.60	U	0.60	U	0.60	U								
IRON	14.3	U	25.3	L	14.3	U								
LEAD	1.3	U	1.3	U	1.3	U								
MAGNESIUM	1860	L	1940	L	1900	L								
MANGANESE	0.95	L	1.4	L	0.51	L								
MERCURY	0.10	U	0.11	LJv	0.10	U								
NICKEL	1.3	L	0.87	L	0.70	U								
POTASSIUM	7100		7290		7530									
SELENIUM	2.2	U	3.4	LJ	2.2	U								
SILVER	0.60	U	0.60	U	0.60	U								
SODIUM	26500		27300		27300									
THALLIUM	3.2	U	4.3	LUC	5.3	LUC								
VANADIUM	0.97	LUC	0.40	U	0.40	U								
ZINC	12.2	LJv	21.9	Jv	3.6	LJv								
CYANIDE	0.90	U	0.90	U	0.90	U								

INORGANIC/ORGANIC COMPLETE SDG FILE (CSF) INVENTORY CHECKLIST

No. 28007 SDG No. MFJK56 SDG Nos. To Follow _____ SAS No. _____ Date Rec 05/11/00

EPA Lab ID: LIBRTY

Lab Location: Cary, NC

Region: 6 Audit No.: 28007/MFJK56

Re_Submitted CSF? Yes _____ No X

Box No(s): 1

COMMENTS:

1. The laboratory did not record the sample tags on Form DC-2 and was notified about this omission.

ORIGINALS	YES	NO	N/A
CUSTODY SEALS			
1. Present on package?	X		
2. Intact upon receipt?	X		
FORM DC-2			
3. Numbering scheme accurate?	X		
4. Are enclosed documents listed?		X	
5. Are listed documents enclosed?	X		
FORM DC-1			
6. Present?	X		
7. Complete?	X		
8. Accurate?	X		
CHAIN-OF-CUSTODY RECORD(s)			
9. Signed?	X		
10. Dated?	X		
TRAFFIC REPORT(s) PACKING LIST(s)			
11. Signed?	X		
12. Dated?	X		
AIRBILLS/AIRBILL STICKER			
13. Present?	X		
14. Signed?	X		
15. Dated?	X		
SAMPLE TAGS			
16. Does DC-1 list tags as being included?	X		
17. Present?	X		
OTHER DOCUMENTS			
18. Complete?	X		
19. Legible?	X		
20. Original?		X	
20a. If "NO", does the copy indicate where original documents are located?	X		

Over for additional comments.

Audited by: Linda Hoffman Linda Hoffman / ESAT Data Reviewer Date 06/11/00

Audited by: _____ _____ Date _____

Audited by: _____ _____ Date _____

Signature Printed Name/Title

TO BE COMPLETED BY CEAT

Date Recvd by CEAT: _____ Date Entered: _____ Date Reviewed: _____

Entered by: _____ _____

Reviewed by: _____ _____

Signature Printed Name/Title

REFERENCE 7

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION 6
HOUSTON BRANCH
10625 FALLSTONE RD.
HOUSTON, TEXAS 77099

MEMORANDUM

Date: July 18, 2000

Subject: Contract Laboratory Program Data Review

From: R. A. Flores for Marvelyn Humphrey, Alternate ESAT RPO, 6MD-HC

To: J.Enders, 6SF-RA

Site : RAY WICHERT PROPERTY

Case#: 28007

SDG# : FGG56

The EPA Region 6 Houston Branch ESAT data review team has completed a review of the submitted Contract Laboratory Program (CLP) data package for the referenced site. The samples analyzed and reviewed are detailed in the attached Regional data review report.

The data package is acceptable for regional use. Problems, if any, are listed in the report narrative.

If you have any questions regarding the data review report, please call me at (281) 983-2140.

Attachments
cc: R. Flores, Region 6 CLP/TPO
M. El-Feky, Region 6 Data Coordinator
Files (2)

LOCKHEED MARTIN SERVICES GROUP
ESAT REGION VI
10101 SOUTHWEST FREEWAY, SUITE 500
HOUSTON, TX 77074

MEMORANDUM

DATE: July 17, 2000

TO: Melvin Ritter/Marvelyn Humphrey, ESAT RPO/Alternate RPO, Region VI

FROM: Tom C.H. Chiang, ESAT Team Manager, Region VI

SUBJECT: CLP Data Review

REF: TDF # 6-0380A ESAT # O-2194
ESAT Contract No. 68-D6-0005

Attached is the data review summary for Case # 28007
SDG # FGG56
Site Ray Wichert Property

COMMENTS:

I. CONTRACTUAL ASSESSMENT OF THE DATA PACKAGE

A. The data package contained the following contractually noncompliant item that was detected by the hardcopy review and CCS audit.

BNA sample FG-G58DL had low internal standard (IS) responses, but the laboratory failed to perform the contract-required reanalysis to confirm the matrix effect (SOW OLM04.2, p. D-53/SVOA, 11.4.3.2.1). The undiluted analysis, FG-G58, could not be used to satisfy the contractual requirement because it had acceptable IS performance. The outlying IS areas caused the qualification of one result for sample FG-G58DL.

B. The hardcopy review detected the following contractually noncompliant item that CCS did not report.

The laboratory submitted two sets of data for Pest/PCB sample FG-G61. However, the diluted analysis, FG-G61DL, is not contractually required. Neither the target compound peak responses nor the matrix interferences could justify the dilution (SOW OLM04.2, p.D-57/PEST, Sec. 10.2.3.2).

LOCKHEED MARTIN SERVICES GROUP
ESAT REGION VI
10101 SOUTHWEST FREEWAY, SUITE 500
HOUSTON, TX 77074

MEMORANDUM

Attached is the data review summary for Case # 28007
SDG # FGG56
Site Ray Wichert Property

COMMENTS:

II. TECHNICAL USABILITY ASSESSMENT OF THE DATA PACKAGE

The total number of results reviewed was 1,317 for this data package. Some results were qualified because of technical problems, and the significant technical problems are summarized below.

1. The instrument for VOA water sample analysis had extremely poor sensitivity for acetone.

2. Field duplicate results were inconsistent for several PAH's, DDE, DDT, and α-chlordane.

3. BNA sample FG-G58DL had two low IS responses.

4. Coeluting matrix interferences obscured the DDT identification in Pest/PCB sample FG-G60.

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION 6
HOUSTON BRANCH
10625 FALLSTONE ROAD
HOUSTON, TEXAS 77099

ORGANIC REGIONAL DATA ASSESSMENT

CASE NO. 28007
LABORATORY SWOK
CONTRACT# 68-W99-079
SDG# FGG56
SOW# RAS SOW OLM04.2
ACCT# 050102DJN70
SF# 50102DZZ

SITE Ray Wichert Property
NO. OF SAMPLES 10
MATRIX 4 Water / 6 Soil
REVIEWER (IF NOT ESD) ESAT
REVIEWER'S NAME Gene Zhu
COMPLETION DATE July 17, 2000

SAMPLE NO.					
FG-G56	FG-G60	FG-G64			
FG-G57	FG-G61	FG-G65			
FG-G58	FG-G62				
FG-G59	FG-G63				

DATA ASSESSMENT SUMMARY

	VOA	BNA	PEST
1. HOLDING TIMES	O	O	O
2. GC/MS TUNE/INSTR. PERFORM.	O	O	O
3. CALIBRATIONS	M	M	O
4. BLANKS	M	O	M
5. SMC/SURROGATES	O	O	O
6. MATRIX SPIKE/DUPLICATE	O	O	O
7. OTHER QC	O	M	M
8. INTERNAL STANDARDS	O	M	N/A
9. COMPOUND ID/QUANTITATION	O	O	M
10. PERFORMANCE/COMPLETENESS	O	O	O
11. OVERALL ASSESSMENT	M	M	M

O = Data had no problems.
M = Data qualified due to major or minor problems.
Z = Data unacceptable.
NA = Not applicable.

ACTION ITEMS: The laboratory failed to perform the contract-required reanalysis for BNA sample FG-G58DL.
AREA OF CONCERN: Acetone and benzaldehyde failed technical %RSD or %D calibration criteria. One VOA instrument had extremely low sensitivity for acetone. Laboratory contamination resulted in raised quantitation limits for some analytes in five VOA and five Pest/PCB samples. BNA and Pest/PCB field duplicates had inconsistent results. BNA sample FG-G58DL had low IS responses. Matrix interferences obscured the DDT detection for Pest/PCB sample FG-G60. Some pesticides had two-column quantitation results differing by more than 25 percent. Pest/PCB sample FG-G61DL was not contractually required.
NOTABLE PERFORMANCE:

COMMENTS/CLARIFICATIONS
REGION VI CLP QA REVIEW

CASE 28007 **SDG** FGG56 **SITE** Ray Wichert Property **LAB** SWOK

The following is a summary of sample qualifiers used by Region 6 in reporting this CLP data:

No.	Acceptable	Provisional	Unacceptable
VOA	1	9	
BNA	5	4	
PEST	3	6	

COMMENTS: This SDG contained six soil samples, two rinsates, and one field blank for complete RAS organics analysis and one trip blank for VOA analysis by OLM04.2. The OTR/COC Records designated samples FG-G56 and FG-G57 as field duplicates, sample FG-G56 as the laboratory QC sample, samples FG-G62 and FG-G63 as rinsates, sample FG-G64 as a field blank, and sample FG-G65 as a trip blank. All soil samples were analyzed at the low level. At the Agency's request, the laboratory performed additional clean up for all soil Pest/PCB extracts using silica gel following SW-846 Method 3630. The CRQL's required %moisture correction for the soil samples. The corrected CRQL's were reported by the laboratory and are referred to as sample quantitation limits (SQL's) in this report. The data package arrived on time for the 21-day contractual turnaround time but contained the contractually noncompliant items below.

- The laboratory failed to reanalyze BNA sample FG-G58DL with outlying IS responses.
- Pest/PCB sample FG-G61DL was not contractually required.

VOA/BNA Four BNA samples were diluted (up to 25X) and analyzed or reanalyzed because of high concentrations of PAH's (up to 63,000 µg/Kg). One other BNA sample contained benzaldehyde at a concentration above the SQL. No target analytes were detected at concentrations above the SQL's/CRQL's in the VOA samples except for the laboratory contaminant methylene chloride. The VOA instrument for water analysis had extremely poor sensitivity for acetone. Many PAH's had inconsistent field duplicate results. BNA sample FG-G58DL had low IS responses.

Pest/PCB Samples FG-G56 and FG-G57 were diluted (10X) and reanalyzed because of high peak responses (up to 180 µg/Kg) for DDE, DDT, and chlordanes on one or both columns. Four other soil samples also contained some pesticides at concentrations above the SQL's. Rinsate sample FG-G63 contained γ-chlordane at a concentration above the CRQL. DDE, DDT, and α-chlordane had inconsistent field duplicate results. Matrix interferences obscured the DDT detection in sample FG-G60.

CASE 28007 **SDG** FGG56 **SITE** Ray Wichert Property **LAB** SWOK

COMMENTS: (continued) Some data are provisional for nine VOA, four BNA, and six Pest/PCB samples because of problems with calibration, laboratory contamination, inconsistent field duplicate results, IS performance, matrix interference, and compound quantitation. The technical usability of all reported sample results is indicated by ESAT's final data qualifiers in the Data Summary Table. An Evidence Audit was conducted for the Complete Sample Delivery Group File (CSF), and the audit results were documented in the Inventory Checklist.

NOTE: THE FOLLOWING REVIEW NARRATIVE ADDRESSES BOTH CONTRACTUAL ISSUES (BASED ON THE STATEMENT OF WORK) AND TECHNICAL ISSUES (BASED ON THE NATIONAL FUNCTIONAL GUIDELINES). THE ASSESSMENT MADE FOR EACH QC PARAMETER IS SOLELY BASED ON THE TECHNICAL DATA USABILITY, WHICH MAY NOT NECESSARILY BE AFFECTED BY CONTRACTUAL PROBLEMS. THE ASSESSMENTS ARE DEFINED BELOW.

Acceptable	=	No results were qualified for any problem associated with this QC parameter.
Provisional	=	Some results were qualified because of problems associated with this QC parameter.
Unusable	=	All results are unusable because of major problems associated with this QC parameter.

1. **Holding Times:** Acceptable. All samples met the contractual holding time criteria. The water samples met the technical holding time criteria (40 CFR Part 136). The laboratory reported elevated cooler temperatures (7.6°C to 9.3°C) that exceeded the contract-specified limit of 6°C. In the reviewer's opinion, the effect of the elevated shipping temperatures is insignificant.

2. **Tuning/Performance:** Acceptable. All analyses met instrument tuning and performance criteria. All Pest/PCB sample analyses met instrument performance guidelines.

3. **Calibrations:** Provisional. TCL compounds met contractual calibration criteria. Some VOA and BNA analytes failed technical %RSD and/or %D calibration criteria, but only results for the following analytes were affected and qualified as estimated:

methylene chloride in VOA samples FG-G56, FG-G57, FG-G58, FG-G59, and FG-G60 and

benzaldehyde in BNA sample FG-G61.

Despite the acceptable RRF's, acetone had an extremely low response (near the noise level) at the CRQL for the water analysis as demonstrated by the manual integration chromatogram submitted with the low point initial calibration standard. The reviewer, therefore, qualified all acetone CRQL's as estimated and biased low for the VOA water samples.

4. **Blanks**: Provisional. The method, storage, and instrument blanks met contractual QC guidelines. The laboratory reported the following target analytes at concentrations below the CRQL's in the BNA and Pest/PCB method blanks: di-n-butylphthalate, bis(2-ethylhexyl)phthalate, heptachlor, and γ-chlordane. The laboratory also reported methylene chloride at a concentration below the CRQL for the VOA storage blank. The effects of the laboratory contamination are summarized below.

> The γ-chlordane results are biased high in Pest/PCB samples FG-G56, FG-G59, FG-G60, and FG-G61.
>
> The remaining laboratory "B"-flagged sample results should be considered as undetected (U) because the concentrations were less than 5X or 10X the associated storage/method blank values. Among the affected results, the heptachlor result in Pest/PCB sample FG-G56, the γ-chlordane result in Pest/PCB sample FG-G57, and the methylene chloride results in VOA samples FG-G56 through FG-G60 were above the SQL's and should be used as raised quantitation limits (M).

Trip blank The VOA trip blank, sample FG-G65, contained chloroform at a concentration below the CRQL. The reviewer recommends that the chloroform results be considered as undetected (U) for rinsate samples FG-G62 and FG-G63 because the chloroform concentrations in these samples were identical to that in the trip blank.

Field blank The field blank, sample FG-G64, contained diethylphthalate, di-n-butylphthalate, and several laboratory contaminants at concentrations below the CRQL's. Since none of the field samples contained diethylphthalate and di-n-butyl-phthalate, results were unaffected.

Rinsates Some laboratory contaminants were detected in the rinsates, samples FG-G62 and FG-G63. The laboratory also reported BNA analyte di-n-butylphthalate (<CRQL) and pesticide γ-chlordane (>CRQL) for rinsate sample FG-G63. The reviewer did not qualify any sample results because information associating the field samples with the rinsates is unavailable.

5. **System Monitoring Compounds (SMC's)/Surrogates**: Acceptable. SMC and surrogate recoveries were within the QC limits with some exceptions. BNA sample FG-G60 had one surrogate recovery exceeding the QC limit, but data qualification was not required. The DCB recovery was marginally below the QC limit for Pest/PCB sample FG-G59. Since this recovery was within the expanded Region 6 limit, no results were qualified.

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6. **Matrix Spike/Matrix Spike Duplicate:** Acceptable. MS/MSD results generally met QC guidelines for precision and %recovery. Exceptions are discussed below. The laboratory could not recover acenaphthene and pyrene from the BNA MS/MSD samples because the native sample concentrations for these two analytes were much higher than the spiked concentration. The laboratory reported a high MS recovery for pesticide DDT. The MS/MSD results for the above-mentioned analytes were not used to assess the matrix effects because they were calculated using analyte concentrations that exceeded the upper calibration limits and may not be accurate.

7. **Other QC:**

Field Duplicate: Provisional. The field duplicate results were generally consistent with the following exceptions.

BNA Many PAH's had much higher concentrations in sample FG-G56 than in its field duplicate, sample FG-G57. The reviewer qualified the reported concentrations for the following analytes as estimated and biased high in sample FG-G56(DL) and estimated and biased low in sample FG-G57(DL): acenaphthene, dibenzofuran, fluorene, phenanthrene, anthracene, and carbazole.

Pest/PCB The concentrations were up to 10X different for DDE, DDT, and α-chlordane in field duplicate samples FG-G56 and FG-G57. The reviewer qualified the results for these pesticides as estimated and biased high in sample FG-G56(DL) and estimated and biased low in sample FG-G57.

8. **Internal Standards (IS):** Provisional. Internal standard performance was acceptable for the VOA and BNA samples with one exception. BNA sample FG-G58DL had low responses for IS5 and IS6, but the laboratory failed to perform the contract-required reanalysis. The undiluted analysis could not be used to demonstrate matrix effect because it had acceptable IS performance. The reviewer qualified the pyrene concentration as estimated for sample FG-G58DL because of the low IS5 response.

9. **Compound Identity/Quantitation:** Provisional. All reported results met compound identification criteria.

VOA The only target compound reported at concentrations above the SQL's was the laboratory contaminant methylene chloride in five soil samples.

BNA The laboratory diluted (up to 25X) and analyzed or reanalyzed samples FG-G56, FG-G57, FG-G58, and FG-G60 because of high PAH concentrations (up to 63,000 µg/Kg). Sample FG-G61 contained benzaldehyde at a concentration above the SQL. The remaining samples did not contain any target analytes with concentrations above the SQL's/CRQL's.

CASE 28007 **SDG** FGG56 **SITE** Ray Wichert Property **LAB** SWOK

9. **Compound Identity/Quantitation:** (continued)
Pest/PCB Samples FG-G56 and FG-G57 were diluted (10X) and reanalyzed because of high concentrations (up to 180 µg/Kg) of DDE, DDT, chlordanes, and several other pesticides. Samples FG-G58, FG-G59, FG-G60, and FG-G61 also contained pesticides at concentrations above the SQL's. Water sample FG-G63 contained γ-chlordane at a concentration above the CRQL. The laboratory diluted (10X) and reanalyzed sample FG-G61 for no apparent reasons. GC/MS confirmation was not required for the reported analytes.

DDT was detected at about 2X the SQL on one column for sample FG-G60. However, a broad coeluting matrix peak obscured the DDT confirmation on the other column. The reviewer qualified the reported DDT SQL as estimated and biased low for sample FG-G60 because of the interference. Sample FG-G58 also had coeluting matrix interferences on one column. Since no target compounds were detected on the other column, result qualification was unnecessary.

All laboratory "P"-flagged results that were above SQL's or CRQL's were qualified as estimated because two-column quantitation results differed by more than 25 percent.

10. **Performance/Completeness:** Acceptable. The data package was complete but had some reporting errors. The laboratory response to CCS (dated 6/6/00) was reviewed. This response has no effect on the sample results. The resubmission was placed at the beginning of the data package and should be used for references only. The laboratory was contacted for other necessary corrections and resubmissions (see Fax Record Log).

11. **Overall Assessment:** Data are acceptable for one VOA, five BNA, and three Pest/PCB samples.

VOA Some results were qualified for the following samples because of problems with calibration and laboratory blank contamination: FG-G56, FG-G57, FG-G58, FG-G59, FG-G60, FG-G62, FG-G63, FG-G64, and FG-G65.

BNA Some results are provisional for the following samples because of problems with calibration, IS performance, and inconsistent field duplicate results: FG-G56(DL), FG-G57(DL), FG-G58(DL), and FG-G61.

Pest/PCB Some results are provisional for the following samples because of problems with laboratory blank contamination, inconsistent field duplicate results, matrix interference, and compound quantitation: FG-G56(DL), FG-G57, FG-G59, FG-G60, FG-G61, and FG-G63.

ORGANIC DATA QUALIFIER DEFINITIONS

The following definitions provide brief explanations of the ESAT-Region 6 qualifiers assigned to results in the Data Summary Table.

U Not detected at reported quantitation limit.

N Identification is tentative.

J Estimated value.

L Reported concentration is below the CRQL.

M Reported concentration should be used as a raised quantitation limit because of interferences and/or laboratory contamination.

R Unusable.

^ High biased. Actual concentration may be lower than the concentration reported.

v Low biased. Actual concentration may be higher than the concentration reported.

F+ A false positive exists.

F- A false negative exists.

B This result may be high biased because of laboratory/field contamination. The reported concentration is above 5X or 10X the concentration reported in the method/field blank.

UJ Estimated quantitation limit.

T Identification is questionable because of absence of other commonly coexisting pesticides.

***** Result not recommended for use because of associated QA/QC performance inferior to that from other analysis.

ORGANIC DATA SUMMARY

Case No. : 28007 SDG : FGG56 Reviewer : Gene Zhu

Laboratory : SWOK Matrix : Soil Units : ug/Kg

VOLATILE EPA SAMPLE NUMBER :	FG-G56	FLAG	FG-G57	FLAG	FG-G58	FLAG	FG-G59	FLAG	FG-G60	FLAG	FG-G61	FLAG	FLAG
Dichlorodifluoromethane	12	U	12	U	12	U	13	U	11	U	13	U	
Chloromethane	12	U	12	U	12	U	13	U	11	U	13	U	
Vinyl Chloride	12	U	12	U	12	U	13	U	11	U	13	U	
Bromomethane	12	U	12	U	12	U	13	U	11	U	13	U	
Chloroethane	12	U	12	U	12	U	13	U	11	U	13	U	
Trichlorofluoromethane	12	U	12	U	12	U	13	U	11	U	13	U	
1,1-Dichloroethene	12	U	12	U	12	U	13	U	11	U	13	U	
1,1,2-Trichloro-1,2,2-trifluoroethane	12	U	12	U	12	U	13	U	11	U	13	U	
Acetone	12	U	12	U	12	U	13	U	11	U	13	U	
Carbon Disulfide	12	U	12	U	12	U	13	U	11	U	13	U	
Methyl Acetate	12	U	12	U	12	U	13	U	11	U	13	U	
Methylene Chloride	17	UJM	17	UJM	14	UJM	16	UJM	15	UJM	13	U	
trans-1,2-Dichloroethene	12	U	12	U	12	U	13	U	11	U	13	U	
Methyl tert-Butyl Ether	12	U	12	U	12	U	13	U	11	U	13	U	
1,1-Dichloroethane	12	U	12	U	12	U	13	U	11	U	13	U	
cis-1,2-Dichloroethene	12	U	12	U	12	U	13	U	11	U	13	U	
2-Butanone	12	U	12	U	12	U	13	U	11	U	13	U	
Chloroform	12	U	12	U	12	U	13	U	11	U	13	U	
1,1,1-Trichloroethane	12	U	12	U	12	U	13	U	11	U	13	U	
Cyclohexane	12	U	12	U	12	U	13	U	11	U	13	U	
Carbon Tetrachloride	12	U	12	U	12	U	13	U	11	U	13	U	
Benzene	12	U	12	U	12	U	13	U	11	U	13	U	
1,2-Dichloroethane	12	U	12	U	12	U	13	U	11	U	13	U	
Trichloroethene	12	U	12	U	12	U	13	U	11	U	13	U	
Methylcyclohexane	12	U	12	U	12	U	13	U	11	U	13	U	
1,2-Dichloropropane	12	U	12	U	12	U	13	U	11	U	13	U	
Bromodichloromethane	12	U	12	U	12	U	13	U	11	U	13	U	
cis-1,3-Dichloropropene	12	U	12	U	12	U	13	U	11	U	13	U	
4-Methyl-2-pentanone	12	U	12	U	12	U	13	U	11	U	13	U	
Toluene	12	U	12	U	4	LJ	13	U	6	LJ	13	U	
trans-1,3-Dichloropropene	12	U	12	U	12	U	13	U	11	U	13	U	
1,1,2-Trichloroethane	12	U	12	U	12	U	13	U	11	U	13	U	
Tetrachloroethene	12	U	12	U	12	U	13	U	11	U	13	U	
2-Hexanone	12	U	12	U	12	U	13	U	11	U	13	U	
Dibromochloromethane	12	U	12	U	12	U	13	U	11	U	13	U	
1,2-Dibromoethane	12	U	12	U	12	U	13	U	11	U	13	U	
Chlorobenzene	12	U	12	U	12	U	13	U	11	U	13	U	
Ethylbenzene	12	U	12	U	12	U	13	U	11	U	13	U	
Xylenes (total)	12	U	12	U	12	U	13	U	11	U	13	U	
Styrene	12	U	12	U	12	U	13	U	11	U	13	U	
Bromoform	12	U	12	U	12	U	13	U	11	U	13	U	
Isopropylbenzene	12	U	12	U	12	U	13	U	11	U	13	U	
1,1,2,2-Tetrachloroethane	12	U	12	U	12	U	13	U	11	U	13	U	
1,3-Dichlorobenzene	12	U	12	U	12	U	13	U	11	U	13	U	
1,4-Dichlorobenzene	12	U	12	U	12	U	13	U	11	U	13	U	
1,2-Dichlorobenzene	12	U	12	U	12	U	13	U	11	U	13	U	
1,2-Dibromo-3-chloropropane	12	U	12	U	12	U	13	U	11	U	13	U	
1,2,4-Trichlorobenzene	12	U	12	U	12	U	13	U	11	U	13	U	
Sample wt (g) :	5		5		5		5		5		5		
%Moisture :	16		19		16		21		11		23		
Dilution Factor :	1		1		1		1		1		1		
Level :	Low		Low		Low		Low		Low		Low		
Number of TIC's :	1		0		0		0		0		0		

Note: For the results listed in the Data Summary Table, ESAT has replaced the laboratory assigned flags with ESAT Organic Data Qualifiers. The ESAT flags indicate the technical usability of the reported results.

ORGANIC DATA SUMMARY

Case No. : 28007 SDG : FGG56 Reviewer : Gene Zhu

Laboratory : SWOK Matrix : Water Units : ug/L

VOLATILE EPA SAMPLE NUMBER	FLAG FG-G62	FLAG FG-G63	FLAG FG-G64	FLAG FG-G65	FLAG	FLAG	FLAG
Dichlorodifluoromethane	10 U	10 U	10 U	10 U			
Chloromethane	10 U	10 U	10 U	10 U			
Vinyl Chloride	10 U	10 U	10 U	10 U			
Bromomethane	10 U	10 U	10 U	10 U			
Chloroethane	10 U	10 U	10 U	10 U			
Trichlorofluoromethane	10 U	10 U	10 U	10 U			
1,1-Dichloroethene	10 U	10 U	10 U	10 U			
1,1,2-Trichloro-1,2,2-trifluoroethane	10 U	10 U	10 U	10 U			
Acetone	10 UJv	10 UJv	10 UJv	10 UJv			
Carbon Disulfide	10 U	10 U	10 U	10 U			
Methyl Acetate	10 U	10 U	10 U	10 U			
Methylene Chloride	10 U	10 U	10 U	10 U			
trans-1,2-Dichloroethene	10 U	10 U	10 U	10 U			
Methyl tert-Butyl Ether	10 U	10 U	10 U	10 U			
1,1-Dichloroethane	10 U	10 U	10 U	10 U			
cis-1,2-Dichloroethene	10 U	10 U	10 U	10 U			
2-Butanone	10 U	10 U	10 U	10 U			
Chloroform	10 U	10 U	10 U	2 LJ			
1,1,1-Trichloroethane	10 U	10 U	10 U	10 U			
Cyclohexane	10 U	10 U	10 U	10 U			
Carbon Tetrachloride	10 U	10 U	10 U	10 U			
Benzene	10 U	10 U	10 U	1 U			
1,2-Dichloroethane	10 U	10 U	10 U	10 U			
Trichloroethene	10 U	10 U	10 U	10 U			
Methylcyclohexane	10 U	10 U	10 U	10 U			
1,2-Dichloropropane	10 U	10 U	10 U	10 U			
Bromodichloromethane	10 U	10 U	10 U	10 U			
cis-1,3-Dichloropropene	10 U	10 U	10 U	10 U			
4-Methyl-2-pentanone	10 U	10 U	10 U	10 U			
Toluene	10 U	10 U	10 U	10 U			
trans-1,3-Dichloropropene	10 U	10 U	10 U	10 U			
1,1,2-Trichloroethane	10 U	10 U	10 U	10 U			
Tetrachloroethene	10 U	10 U	10 U	10 U			
2-Hexanone	10 U	10 U	10 U	10 U			
Dibromochloromethane	10 U	10 U	10 U	10 U			
1,2-Dibromoethane	10 U	10 U	10 U	10 U			
Chlorobenzene	10 U	10 U	10 U	10 U			
Ethylbenzene	10 U	10 U	10 U	10 U			
Xylenes (total)	10 U	10 U	10 U	10 U			
Styrene	10 U	10 U	10 U	10 U			
Bromoform	10 U	10 U	10 U	10 U			
Isopropylbenzene	10 U	10 U	10 U	10 U			
1,1,2,2-Tetrachloroethane	10 U	10 U	10 U	10 U			
1,3-Dichlorobenzene	10 U	10 U	10 U	10 U			
1,4-Dichlorobenzene	10 U	10 U	10 U	10 U			
1,2-Dichlorobenzene	10 U	10 U	10 U	10 U			
1,2-Dibromo-3-chloropropane	10 U	10 U	10 U	10 U			
1,2,4-Trichlorobenzene	10 U	10 U	10 U	10 U			
Volume (ml) :	5	5	5	5			
Dilution Factor :	1	1	1	1			
Number of TIC's :	0	0	0	0			

Note: For the results listed in the Data Summary Table, ESAT has replaced the laboratory assigned flags with ESAT Organic Data Qualifiers. The ESAT flags indicate the technical usability of the reported results.

ORGANIC DATA SUMMARY

Case No. : 28007 SDG : FGG56 Reviewer : Gene Zhu

Laboratory : SWOK Matrix : Soil Units : ug/Kg

SEMIVOLATILE EPA SAMPLE NUMBER :	FG-G56	FLAG	FG-G56DL	FLAG	FG-G57	FLAG	FG-G57DL	FLAG	FG-G58	FLAG	FG-G58DL	FLAG	FG-G59	FLAG
Benzaldehyde	120	LJ	9700	U*	160	LJ	9900	U*	190	LJ	3800	U*	170	LJ
Phenol	1900	U	9700	U*	2000	U	9900	U*	1900	U	3800	U*	410	U
bis-(2-Chloroethyl) ether	1900	U	9700	U*	2000	U	9900	U*	1900	U	3800	U*	410	U
2-Chlorophenol	1900	U	9700	U*	2000	U	9900	U*	1900	U	3800	U*	410	U
2-Methylphenol	1900	U	9700	U*	2000	U	9900	U*	1900	U	3800	U*	410	U
2,2'-oxybis(1-Chloropropane)	1900	U	9700	U*	2000	U	9900	U*	1900	U	3800	U*	410	U
Acetophenone	1900	U	9700	U*	2000	U	9900	U*	1900	U	3800	U*	410	U
4-Methylphenol	100	LJ	9700	U*	2000	U	9900	U*	1900	U	3800	U*	59	LJ
N-Nitroso-di-n-propylamine	1900	U	9700	U*	2000	U	9900	U*	1900	U	3800	U*	410	U
Hexachloroethane	1900	U	9700	U*	2000	U	9900	U*	1900	U	3800	U*	410	U
Nitrobenzene	1900	U	9700	U*	2000	U	9900	U*	1900	U	3800	U*	410	U
Isophorone	1900	U	9700	U*	2000	U	9900	U*	1900	U	3800	U*	410	U
2-Nitrophenol	1900	U	9700	U*	2000	U	9900	U*	1900	U	3800	U*	410	U
2,4-Dimethylphenol	1900	U	9700	U*	2000	U	9900	U*	1900	U	3800	U*	410	U
bis(2-Chloroethoxy)methane	1900	U	9700	U*	2000	U	9900	U*	1900	U	3800	U*	410	U
2,4-Dichlorophenol	1900	U	9700	U*	2000	U	9900	U*	1900	U	3800	U*	410	U
Naphthalene	1400	LJ	1500	*	200	LJ	9900	U*	220	LJ	200	*	23	LJ
4-Chloroaniline	1900	U	9700	U*	2000	U	9900	U*	1900	U	3800	U*	410	U
Hexachlorobutadiene	1900	U	9700	U*	2000	U	9900	U*	1900	U	3800	U*	410	U
Caprolactam	1900	U	9700	U*	2000	U	9900	U*	1900	U	3800	U*	410	U
4-Chloro-3-methylphenol	1900	U	9700	U*	2000	U	9900	U*	1900	U	3800	U*	410	U
2-Methylnaphthalene	1000	LJ	1500	*	2000	U	9900	U*	1900	U	3800	U*	28	LJ
Hexachlorocyclopentadiene	1900	U	9700	U*	2000	U	9900	U*	1900	U	3800	U*	410	U
2,4,6-Trichlorophenol	1900	U	9700	U*	2000	U	9900	U*	1900	U	3800	U*	410	U
2,4,5-Trichlorophenol	4900	U	24000	U*	5000	U	25000	U*	4800	U	9500	U*	1000	U
1,1'-Biphenyl	540	LJ	810	*	2000	U	9900	U*	1900	U	3800	U*	410	U
2-Chloronaphthalene	1900	U	9700	U*	2000	U	9900	U*	1900	U	3800	U*	410	U
2-Nitroaniline	4900	U	24000	U*	5000	U	25000	U*	4800	U	9500	U*	1000	U
Dimethylphthalate	1900	U	9700	U*	2000	U	9900	U*	1900	U	3800	U*	410	U
2,6-Dinitrotoluene	1900	U	9700	U*	2000	U	9900	U*	1900	U	3800	U*	410	U
Acenaphthylene	370	LJ	9700	U*	1300	LJ	9900	U*	240	LJ	3800	U*	92	LJ
3-Nitroaniline	4900	U	24000	U*	5000	U	25000	U*	4800	U	9500	U*	1000	U
Acenaphthene	7000	JA	7900	*	1800	LJv	2000	*	1100	LJ	1100	*	21	LJ
2,4-Dinitrophenol	4900	U	24000	U*	5000	U	25000	U*	4800	U	9500	U*	1000	U
4-Nitrophenol	4900	U	24000	U*	5000	U	25000	U*	4800	U	9500	U*	1000	U
Dibenzofuran	5000	JA	5500	*	750	LJv	860	*	410	LJ	480	*	30	LJ
2,4-Dinitrotoluene	1900	U	9700	U*	2000	U	9900	U*	1900	U	3800	U*	410	U
Diethylphthalate	1900	U	9700	U*	2000	U	9900	U*	1900	U	3800	U*	410	U
Fluorene	8100	JA	9200	*	1900	LJv	2000	*	1000	LJ	950	*	410	U
4-Chlorophenyl-phenyl ether	1900	U	9700	U*	2000	U	9900	U*	1900	U	3800	U*	410	U
4-Nitroaniline	4900	U	24000	U*	5000	U	25000	U*	4800	U	9500	U*	1000	U
4,6-Dinitro-2-methylphenol	4900	U	24000	U*	5000	U	25000	U*	4800	U	9500	U*	1000	U
N-Nitrosodiphenylamine	1900	U	9700	U*	2000	U	9900	U*	1900	U	3800	U*	410	U
4-Bromophenyl-phenylether	1900	U	9700	U*	2000	U	9900	U*	1900	U	3800	U*	410	U
Hexachlorobenzene	1900	U	9700	U*	2000	U	9900	U*	1900	U	3800	U*	410	U
Atrazine	1900	U	9700	U*	2000	U	9900	U*	1900	U	3800	U*	410	U
Pentachlorophenol	4900	U	24000	U*	5000	U	25000	U*	4800	U	9500	U*	1000	U
Phenanthrene	54000	*	54000	JA	22000	*	22000	Jv	11000	*	11000	*	130	LJ
Anthracene	17000	*	17000	JA	5800	Jv	5600	*	2600	*	2500	*	47	LJ
Carbazole	9800	JA	10000	*	2200	Jv	2100	*	1700	LJ	1400	*	31	LJ

Note: For the results listed in the Data Summary Table, ESAT has replaced the laboratory assigned flags with ESAT Organic Data Qualifiers. The ESAT flags indicate the technical usability of the reported results.

ORGANIC DATA SUMMARY

Case No. : 28007 SDG : FGG56 Reviewer : Gene Zhu

Laboratory : SWOK Matrix : Soil Units : ug/Kg

SEMIVOLATILE EPA SAMPLE NUMBER :	FG-G56	FLAG	FG-G56DL	FLAG	FG-G57	FLAG	FG-G57DL	FLAG	FG-G58	FLAG	FG-G58DL	FLAG	FG-G59	FLAG
Di-n-butylphthalate	1900	U	9700	U*	2000	U	9900	U*	1900	U	3800	U*	410	U
Fluoranthene	65000	*	63000		39000	*	39000		19000	*	15000		250	LJ
Pyrene	52000	*	52000		29000	*	29000		16000	*	16000	J	230	LJ
Butylbenzylphthalate	1900	U	9700	U*	2000	U	9900	U*	1900	U	3800	U*	410	U
3,3'-Dichlorobenzidine	1900	U	9700	U*	2000	U	9900	U*	1900	U	3800	U*	410	U
Benzo(a)anthracene	29000	*	32000		18000	*	19000		7600		7200	*	120	LJ
Chrysene	30000	*	32000		19000	*	20000		8500		7500	*	190	LJ
bis(2-Ethylhexyl)phthalate	1900	U	9700	U*	2000	U	9900	U*	1900	U	3800	U*	410	U
Di-n-octylphthalate	1900	U	9700	U*	190	LJ	9900	U*	1900	U	3800	U*	410	U
Benzo(b)fluoranthene	25000	*	35000	J^	16000	Jv	24000	*	6800		9900	*	210	LJ
Benzo(k)fluoranthene	24000	*	15000		17000	*	8600	LJ	7900		3400	*	180	LJ
Benzo(a)pyrene	25000	*	26000		16000		16000	*	7600		6900	*	160	LJ
Indeno(1,2,3-cd)pyrene	13000		12000	*	8300		8500	*	4000		4500	*	100	LJ
Dibenzo(a,h)anthracene	6900		3500	*	3600		2400	*	1900		1100	*	40	LJ
Benzo(g,h,i)perylene	13000		13000	*	8200		8700		4400		5200		110	LJ
Sample wt (g) :	30.5		30.5		30.8		30.8		30.9		30.9		30.4	
%Moisture :	16		16		19		19		16		15		21	
Dilution Factor :	5		25		5		25		5		10		1	
Level :	Low		Low		Low		Low		Low		Low		Low	
Number of TIC's :	30		22		30		14		30		16		30	

Note: For the results listed in the Data Summary Table, ESAT has replaced the laboratory assigned flags with ESAT Organic Data Qualifiers. The ESAT flags indicate the technical usability of the reported results.

ORGANIC DATA SUMMARY

Case No. : 28007 SDG : FGG56 Reviewer : Gene Zhu

Laboratory : SWOK Matrix : Soil Units : ug/Kg

SEMIVOLATILE EPA SAMPLE NUMBER :		FLAG FG-G60		FLAG FG-G61	FLAG	FLAG	FLAG	FLAG	FLAG
Benzaldehyde	1800	U	430	U					
Phenol	1800	U	400	U					
bis-(2-Chloroethyl) ether	1800	U	400	U					
2-Chlorophenol	1800	U	400	U					
2-Methylphenol	1800	U	400	U					
2,2'-oxybis(1-Chloropropane)	1800	U	400	U					
Acetophenone	1800	U	48	LJ					
4-Methylphenol	1800	U	400	U					
N-Nitroso-di-n-propylamine	1800	U	400	U					
Hexachloroethane	1800	U	400	U					
Nitrobenzene	1800	U	400	U					
Isophorone	1800	U	400	U					
2-Nitrophenol	1800	U	400	U					
2,4-Dimethylphenol	1800	U	400	U					
bis(2-Chloroethoxy)methane	1800	U	400	U					
2,4-Dichlorophenol	1800	U	400	U					
Naphthalene	1800	U	400	U					
4-Chloroaniline	1800	U	400	U					
Hexachlorobutadiene	1800	U	400	U					
Caprolactam	1800	U	400	U					
4-Chloro-3-methylphenol	1800	U	400	U					
2-Methylnaphthalene	1800	U	400	U					
Hexachlorocyclopentadiene	1800	U	400	U					
2,4,6-Trichlorophenol	1800	U	400	U					
2,4,5-Trichlorophenol	4500	U	1000	U					
1,1'-Biphenyl	1800	U	400	U					
2-Chloronaphthalene	1800	U	400	U					
2-Nitroaniline	4500	U	1000	U					
Dimethylphthalate	1800	U	400	U					
2,6-Dinitrotoluene	1800	U	400	U					
Acenaphthylene	160	LJ	44	LJ					
3-Nitroaniline	4500	U	1000	U					
Acenaphthene	400	LJ	400	U					
2,4-Dinitrophenol	4500	U	1000	U					
4-Nitrophenol	4500	U	1000	U					
Dibenzofuran	180	LJ	400	U					
2,4-Dinitrotoluene	1800	U	400	U					
Diethylphthalate	1800	U	400	U					
Fluorene	400	LJ	400	U					
4-Chlorophenyl-phenyl ether	1800	U	400	U					
4-Nitroaniline	4500	U	1000	U					
4,6-Dinitro-2-methylphenol	4500	U	1000	U					
N-Nitrosodiphenylamine	1800	U	400	U					
4-Bromophenyl-phenylether	1800	U	400	U					
Hexachlorobenzene	1800	U	400	U					
Atrazine	1800	U	400	U					
Pentachlorophenol	4500	U	1000	U					
Phenanthrene	4400		40	LJ					
Anthracene	1000	LJ	400	U					
Carbazole	710	LJ	400	U					

Note: For the results listed in the Data Summary Table, ESAT has replaced the laboratory assigned flags with ESAT Organic Data Qualifiers. The ESAT flags indicate the technical usability of the reported results.

ORGANIC DATA SUMMARY

Case No. : 28007 SDG : FGG56 Reviewer : Gene Zhu

Laboratory : SWOK Matrix : Soil Units : ug/Kg

SEMIVOLATILE EPA SAMPLE NUMBER :	FG-G60	FLAG	FG-G61	FLAG		FLAG		FLAG		FLAG		FLAG
Di-n-butylphthalate	1800	U	400	U								
Fluoranthene	7700		79	LJ								
Pyrene	6700		67	LJ								
Butylbenzylphthalate	1800	U	400	U								
3,3'-Dichlorobenzidine	1800	U	400	U								
Benzo(a)anthracene	3000		34	LJ								
Chrysene	3500		54	LJ								
bis(2-Ethylhexyl)phthalate	1800	U	400	U								
Di-n-octylphthalate	1800	U	400	U								
Benzo(b)fluoranthene	2900		75	LJ								
Benzo(k)fluoranthene	3500		400	U								
Benzo(a)pyrene	3200		37	LJ								
Indeno(1,2,3-cd)pyrene	1800		26	LJ								
Dibenzo(a,h)anthracene	740	LJ	400	U								
Benzo(g,h,i)perylene	2100		29	LJ								
Sample wt (g) :	31.2		32.2									
%Moisture :	11		23									
Dilution Factor :	5		1									
Level :	Low		Low									
Number of TIC's :	30		30									

Note: For the results listed in the Data Summary Table, ESAT has replaced the laboratory assigned flags with ESAT Organic Data Qualifiers. The ESAT flags indicate the technical usability of the reported results.

Case No. : 28007 SDG : FGG56 Reviewer : Gene Zhu

Laboratory : SWOK Matrix : Water Units : ug/L

SEMIVOLATILE EPA SAMPLE NUMBER	FLAG FG-G62	FLAG FG-G63	FLAG FG-G64	FLAG	FLAG	FLAG	FLAG
Benzaldehyde	10 U	10 U	10 U				
Phenol	10 U	10 U	10 U				
bis-(2-Chloroethyl) ether	10 U	10 U	10 U				
2-Chlorophenol	10 U	10 U	10 U				
2-Methylphenol	10 U	10 U	10 U				
2,2'-oxybis(1-Chloropropane)	10 U	10 U	10 U				
Acetophenone	10 U	10 U	10 U				
4-Methylphenol	10 U	10 U	10 U				
N-Nitroso-di-n-propylamine	10 U	10 U	10 U				
Hexachloroethane	10 U	10 U	10 U				
Nitrobenzene	10 U	10 U	10 U				
Isophorone	10 U	10 U	10 U				
2-Nitrophenol	10 U	10 U	10 U				
2,4-Dimethylphenol	10 U	10 U	10 U				
bis(2-Chloroethoxy)methane	10 U	10 U	10 U				
2,4-Dichlorophenol	10 U	10 U	10 U				
Naphthalene	10 U	10 U	10 U				
4-Chloroaniline	10 U	10 U	10 U				
Hexachlorobutadiene	10 U	10 U	10 U				
Caprolactam	10 U	10 U	10 U				
4-Chloro-3-methylphenol	10 U	10 U	10 U				
2-Methylnaphthalene	10 U	10 U	10 U				
Hexachlorocyclopentadiene	10 U	10 U	10 U				
2,4,6-Trichlorophenol	10 U	10 U	10 U				
2,4,5-Trichlorophenol	25 U	25 U	25 U				
1,1'-Biphenyl	10 U	10 U	10 U				
2-Chloronaphthalene	10 U	10 U	10 U				
2-Nitroaniline	25 U	25 U	25 U				
Dimethylphthalate	10 U	10 U	10 U				
2,6-Dinitrotoluene	10 U	10 U	10 U				
Acenaphthylene	10 U	10 U	10 U				
3-Nitroaniline	25 U	25 U	25 U				
Acenaphthene	10 U	10 U	10 U				
2,4-Dinitrophenol	25 U	25 U	25 U				
4-Nitrophenol	25 U	25 U	25 U				
Dibenzofuran	10 U	10 U	10 U				
2,4-Dinitrotoluene	10 U	10 U	10 U				
Diethylphthalate	10 U	10 U	0.5 UJ				
Fluorene	10 U	10 U	10 U				
4-Chlorophenyl-phenyl ether	10 U	10 U	10 U				
4-Nitroaniline	25 U	25 U	25 U				
4,6-Dinitro-2-methylphenol	25 U	25 U	25 U				
N-Nitrosodiphenylamine	10 U	10 U	10 U				
4-Bromophenyl-phenylether	10 U	10 U	10 U				
Hexachlorobenzene	10 U	10 U	10 U				
Atrazine	10 U	10 U	10 U				
Pentachlorophenol	25 U	25 U	25 U				
Phenanthrene	10 U	10 U	10 U				
Anthracene	10 U	10 U	10 U				
Carbazole	10 U	10 U	10 U				
Di-n-butylphthalate	10 U	0.7 UJ	0.7 UJ				
Fluoranthene	10 U	10 U	10 U				
Pyrene	10 U	10 U	10 U				
Butylbenzylphthalate	10 U	10 U	10 U				

Note: For the results listed in the Data Summary Table, ESAT has replaced the laboratory assigned flags with ESAT Organic Data Qualifiers. The ESAT flags indicate the technical usability of the reported results.

ORGANIC DATA SUMMARY

Case No. : 28007 SDG : FGG56 Reviewer : Gene Zhu

Laboratory : SWOK Matrix : Water Units : ug/L

SEMIVOLATILE EPA SAMPLE NUMBER :		FLAG FG-G62		FLAG FG-G63		FLAG FG-G64		FLAG		FLAG		FLAG		FLAG
3,3'-Dichlorobenzidine	10	U	10	U	10	U								
Benzo(a)anthracene	10	U	10	U	10	U								
Chrysene	10	U	10	U	10	U								
bis(2-Ethylhexyl)phthalate	10	U	10	U	10	U								
Di-n-octylphthalate	10	U	10	U	10	U								
Benzo(b)fluoranthene	10	U	10	U	10	U								
Benzo(k)fluoranthene	10	U	10	U	10	U								
Benzo(a)pyrene	10	U	10	U	10	U								
Indeno(1,2,3-cd)pyrene	10	U	10	U	10	U								
Dibenzo(a,h)anthracene	10	U	10	U	10	U								
Benzo(g,h,i)perylene	10	U	10	U	10	U								
Volume (ml) :	1000		1000		1000									
Dilution Factor :	1		1		1									
Number of TIC's :	3		3		7									

Note: For the results listed in the Data Summary Table, ESAT has replaced the laboratory assigned flags with ESAT Organic Data Qualifiers. The ESAT flags indicate the technical usability of the reported results.

ORGANIC DATA SUMMARY

Case No. : 28007 SDG : FGG56 Reviewer : Gene Zhu

Laboratory : SWOK Matrix : Soil Units : ug/Kg

PESTICIDES/PCBs EPA SAMPLE NUMBER :	FLAG FG-G56	FLAG FG-G56DL	FLAG FG-G57	FLAG FG-G57DL	FLAG FG-G58	FLAG FG-G59	FLAG FG-G60
alpha-BHC	2.0 U	20 U *	2.1 U	21 U *	2.0 U	2.2 U	1.9 U
beta-BHC	2.0 U	20 U *	2.1 U	21 U *	2.0 U	2.2 U	1.9 U
delta-BHC	2.0 U	20 U *	2.1 U	21 U *	2.0 U	2.2 U	1.9 U
gamma-BHC (Lindane)	2.0 U	20 U *	2.1 U	21 U *	2.0 U	2.2 U	1.9 U
Heptachlor	3.0 UM	20 U *	2.1 U	21 U *	2.0 U	2.2 U	1.9 U
Aldrin	2.0 U	20 U *	2.1 U	21 U *	2.0 U	2.2 U	1.9 U
Heptachlor epoxide	0.90 LJ	20 U *	2.1 U	21 U *	2.0 U	2.2 U	1.9 U
Endosulfan I	2.0 U	20 U *	2.1 U	21 U *	2.0 U	2.2 U	1.9 U
Dieldrin	2.1 LJ	39 U *	4.1 U	41 U *	5.4	0.83 LJ	3.6 U
4,4'-DDE	91 *	86 J^	7.9 Jv	84 *	3.8 U	4.2 U	5.7 J
Endrin	4.7 J	39 U *	4.1 U	41 U *	3.8 U	3.2 LJ	4.8 J
Endosulfan II	4.0 J	10 *	4.1 U	41 U *	3.8 U	0.58 LJ	3.6 U
4,4'-DDD	6.6 J	39 U *	4.1 U	41 U *	3.8 U	0.95 LJ	3.6 U
Endosulfan sulfate	3.9 U	39 U *	4.1 U	41 U *	3.8 U	4.2 U	3.6 U
4,4'-DDT	170 *	180 J^	29 Jv	190 *	3.8 U	13	3.6 UJv
Methoxychlor	2.7 LJ	200 U *	21 U	210 U *	20 U	22 U	19 U
Endrin ketone	14	39 U *	16	41 U *	3.8 U	4.2 U	3.6 U
Endrin aldehyde	1.8 LJ	39 U *	2.1 LJ	41 U *	3.8 U	4.2 U	3.6 U
alpha-Chlordane	11 J^	9.9 *	3.1 Jv	11 *	2.0 U	2.2 U	1.9 U
gamma-Chlordane	7.0 B	6.9 *	3.8 UM	8.5 *	2.0 U	7.8 B	7.0 JB
Toxaphene	200 U	2000 U *	210 U	2100 U *	200 U	220 U	190 U
Aroclor-1016	39 U	390 U *	41 U	410 U *	38 U	42 U	36 U
Aroclor-1221	78 U	780 U *	82 U	820 U *	78 U	85 U	74 U
Aroclor-1232	39 U	390 U *	41 U	410 U *	38 U	42 U	36 U
Aroclor-1242	39 U	390 U *	41 U	410 U *	38 U	42 U	36 U
Aroclor-1248	39 U	390 U *	41 U	410 U *	38 U	42 U	36 U
Aroclor-1254	39 U	390 U *	41 U	410 U *	38 U	42 U	36 U
Aroclor-1260	39 U	390 U *	41 U	410 U *	38 U	42 U	36 U
Sample wt (g) :	30.6	30.6	30.1	30.1	30.8	30	30.6
%Moisture :	16	16	19	19	16	21	11
Dilution Factor :	1	10	1	10	1	1	1

Note: For the results listed in the Data Summary Table, ESAT has replaced the laboratory assigned flags with ESAT Organic Data Qualifiers. The ESAT flags indicate the technical usability of the reported results.

ORGANIC DATA SUMMARY

Case No. : 28007 SDG : FGG56 Reviewer : Gene Zhu

Laboratory : SWOK Matrix : Soil Units : ug/Kg

PESTICIDES/PCBs EPA SAMPLE NUMBER :	FG-G61	FLAG	FG-G61DL	FLAG		FLAG		FLAG		FLAG		FLAG
alpha-BHC	2.2	U	22	U	*							
beta-BHC	2.2	U	22	U	*							
delta-BHC	2.2	U	22	U	*							
gamma-BHC (Lindane)	2.2	U	22	U	*							
Heptachlor	2.2	U	22	U	*							
Aldrin	2.2	U	22	U	*							
Heptachlor epoxide	2.2	U	22	U	*							
Endosulfan I	2.2	U	22	U	*							
Dieldrin	4.2	U	42	U	*							
4,4'-DDE	6.8	J	8.8		*							
Endrin	1.0	LJ	42	U	*							
Endosulfan II	0.94	LJ	42	U	*							
4,4'-DDD	4.2	U	42	U	*							
Endosulfan sulfate	4.2	U	42	U	*							
4,4'-DDT	4.2	U	42	U	*							
Methoxychlor	22	U	220	U	*							
Endrin ketone	4.2	U	42	U	*							
Endrin aldehyde	4.1	LJ	42	U	*							
alpha-Chlordane	0.84	LJ	22	U	*							
gamma-Chlordane	9.3	JB	8.0		*							
Toxaphene	220	U	2200	U	*							
Aroclor-1016	42	U	420	U	*							
Aroclor-1221	85	U	850	U	*							
Aroclor-1232	42	U	420	U	*							
Aroclor-1242	42	U	420	U	*							
Aroclor-1248	42	U	420	U	*							
Aroclor-1254	42	U	420	U	*							
Aroclor-1260	42	U	420	U	*							
Sample wt (g) :	30.6		30.6									
%Moisture :	23		23									
Dilution Factor :	1		10									

Note: For the results listed in the Data Summary Table, ESAT has replaced the laboratory assigned flags with ESAT Organic Data Qualifiers. The ESAT flags indicate the technical usability of the reported results.

ORGANIC DATA SUMMARY

Case No. : 28007 SDG : FGG56 Reviewer : Gene Zhu

Laboratory : SWOK Matrix : Water Units : ug/L

PESTICIDES/PCBs EPA SAMPLE NUMBER :	FG-G62	FLAG	FG-G63	FLAG	FG-G64	FLAG		FLAG		FLAG		FLAG		FLAG
alpha-BHC	0.050	U	0.050	U	0.050	U								
beta-BHC	0.050	U	0.050	U	0.050	U								
delta-BHC	0.050	U	0.050	U	0.050	U								
gamma-BHC (Lindane)	0.050	U	0.050	U	0.050	U								
Heptachlor	0.050	U	0.050	U	0.050	U								
Aldrin	0.050	U	0.050	U	0.050	U								
Heptachlor epoxide	0.050	U	0.050	U	0.050	U								
Endosulfan I	0.050	U	0.050	U	0.050	U								
Dieldrin	0.10	U	0.10	U	0.10	U								
4,4'-DDE	0.10	U	0.10	U	0.10	U								
Endrin	0.10	U	0.10	U	0.10	U								
Endosulfan II	0.10	U	0.10	U	0.10	U								
4,4'-DDD	0.10	U	0.10	U	0.10	U								
Endosulfan sulfate	0.10	U	0.10	U	0.10	U								
4,4'-DDT	0.10	U	0.10	U	0.10	U								
Methoxychlor	0.50	U	0.50	U	0.50	U								
Endrin ketone	0.10	U	0.10	U	0.10	U								
Endrin aldehyde	0.10	U	0.10	U	0.10	U								
alpha-Chlordane	0.050	U	0.050	U	0.050	U								
gamma-Chlordane	0.050	U	0.054	J	0.050	U								
Toxaphene	5.0	U	5.0	U	5.0	U								
Aroclor-1016	1.0	U	1.0	U	1.0	U								
Aroclor-1221	2.0	U	2.0	U	2.0	U								
Aroclor-1232	1.0	U	1.0	U	1.0	U								
Aroclor-1242	1.0	U	1.0	U	1.0	U								
Aroclor-1248	1.0	U	1.0	U	1.0	U								
Aroclor-1254	1.0	U	1.0	U	1.0	U								
Aroclor-1260	1.0	U	1.0	U	1.0	U								
Volume (ml) :	1000		1000		1000									
Dilution Factor :	1		1		1									

Note: For the results listed in the Data Summary Table. ESAT has replaced the laboratory assigned flags with ESAT Organic Data Qualifiers. The ESAT flags indicate the technical usability of the reported results.

INORGANIC/ORGANIC COMPLETE SDG FILE (CSF) INVENTORY CHECKLIST

Case No. 28007 SDG No. FGG56 SDG Nos. To Follow SAS No. Date Rec 05/19/00

EPA Lab ID: SWOK

Lab Location: 1700 West Albany, Broken Arrow, OK 74012

Region: 6 Audit No.: 28007/FGG56

Re-Submitted CSF? Yes _____ No X

Box No(s): 1

COMMENTS:

Item	Description
3	Two sections of Form DC-1, p. 1423, reported inconsistent cooler temperatures. The laboratory was contacted for clarification.

Over for additional comments.

ORIGINALS	YES	NO	N/A
CUSTODY SEALS			
1. Present on package?	X		
2. Intact upon receipt?	X		
FORM DC-2			
3. Numbering scheme accurate?	X		
4. Are enclosed documents listed?	X		
5. Are listed documents enclosed?	X		
FORM DC-1			
6. Present?	X		
7. Complete?	X		
8. Accurate?		X	
CHAIN-OF-CUSTODY RECORD(s)			
9. Signed?	X		
10. Dated?	X		
TRAFFIC REPORT(s) PACKING LIST(s)			
11. Signed?	X		
12. Dated?	X		
AIRBILLS/AIRBILL STICKER			
13. Present?	X		
14. Signed?	X		
15. Dated?	X		
SAMPLE TAGS			
16. Does DC-1 list tags as being included?	X		
17. Present?	X		
OTHER DOCUMENTS			
18. Complete?	X		
19. Legible?	X		
20. Original?		X	
20a. If "NO", does the copy indicate where original documents are located?	X		

Audited by: _____ Tseng-Ying Fan/ ESAT Data Reviewer Date 07/14/2000

Audited by: _____ _____ Date _____

Audited by: _____ _____ Date _____

Signature Printed Name/Title

TO BE COMPLETED BY CEAT

Date Recvd by CEAT: _____ Date Entered: _____ Date Reviewed: _____

Entered by: _____ _____

Reviewed by: _____ _____

Signature Printed Name/Title

REFERENCE 8

OKLAHOMA GEOLOGICAL SURVEY
Charles J. Mankin, *Director*

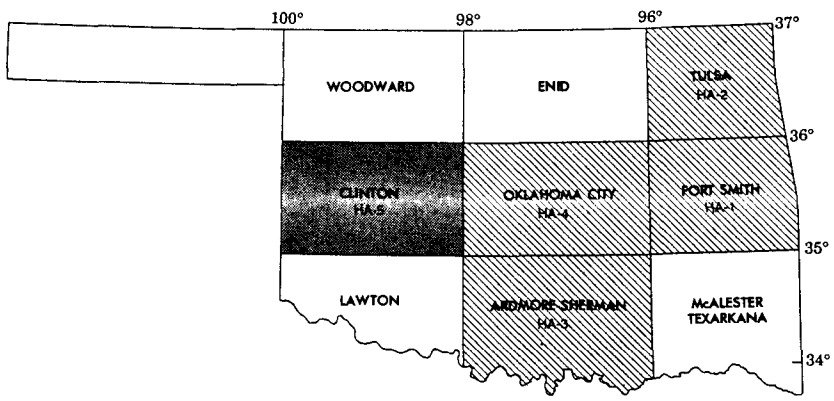
HYDROLOGIC ATLAS 5

RECONNAISSANCE OF THE WATER RESOURCES OF THE CLINTON QUADRANGLE WEST-CENTRAL OKLAHOMA

By

JERRY E. CARR and DEROY L. BERGMAN
U.S. Geological Survey

Prepared in cooperation with
UNITED STATES GEOLOGICAL SURVEY



Scale 1:250,000

The University of Oklahoma
Norman
1976
Second Printing, 1992

EXPLANATION

The stratigraphic nomenclature and age determinations used herein are those accepted by the Oklahoma Geological Survey and do not necessarily agree with those of the U.S. Geological Survey.

Qds

DUNE SAND

Wind-blown sand; thickness ranges from a thin veneer to about 70 feet.

Qal

ALLUVIUM

Stream-laid deposits of sand, silt, clay, and gravel; thickness ranges from 0 to about 170 feet.

Ql

TERRACE DEPOSITS

Stream-laid deposits of sand, silt, clay, gravel, and volcanic ash; thickness ranges from 0 to about 120 feet.

UNCONFORMITY

To

OGALLALA FORMATION

Gray to light-brown, fine- to medium-grained sand with some clay, silt, gravel, volcanic ash, and caliche beds; locally cemented by calcium carbonate. Thickness ranges from 0 to about 320 feet. The formation thins eastward.

UNCONFORMITY

Kd

Kk

KIOWA FORMATION and DAKOTA GROUP

Outliers of the *Kiowa Formation,* Kk, dark-gray shale with some thin beds of fossiliferous tan limestone, range in thickness from a few feet to about 20 feet. Associated in some places is a 5- to 10-foot, gray to brown, coarse-grained sandstone and conglomerate assigned to the overlying *Dakota Group,* Kd (lower sandstone part). Several hundred outliers occur (generally too small to show on map) west of U.S. Highway 183, resting on units ranging from the Rush Springs Formation to the Elk City Sandstone.

UNCONFORMITY

Pec

ELK CITY SANDSTONE

Reddish-brown, fine-grained sandstone with minor amounts of silt and clay, weakly cemented by iron oxide, calcium carbonate, and gypsum; maximum thickness 185 feet, top eroded.

Pdy

DOXEY SHALE

Reddish-brown, silty shale and siltstone; thickness, about 190 feet.

Pcc

CLOUD CHIEF FORMATION

Reddish-brown to orange-brown shale, interbedded with siltstone and sandstone in the middle part and some dolomite and much gypsum in lower part; thickness about 400 feet, thinning northward to about 175 feet. The *Moccasin Creek Gypsum Member* is at the base.

Pwh

Prw

Pr

Pm

Pmv

WHITEHORSE GROUP

Predominantly orange-brown, fine-grained sandstone, the *Whitehorse Group* is mapped as Pwh where separate formations have not been distinguished and as the *Rush Springs Formation* and the *Marlow Formation* where identified.

Rush Springs Formation, Pr, orange-brown, cross-bedded, fine-grained sandstone with some dolomite and gypsum beds. Thickness, about 300 feet, thinning northward to about 186 feet. The *Weatherford Gypsum Bed,* Prw, is about 30 to 60 feet below the top (mapped in southeastern part only).

Marlow Formation, Pm, orange-brown, fine-grained sandstone and siltstone, about 100 to 130 feet thick, thinning northward. This formation has 2 gypsum and (or) dolomite beds in upper 20 feet—the *Emanuel Bed* (at top) and the *Relay Creek Bed* (20 feet below top). Two thin, pink shales occur; the first is 1 foot below the top *(Gracemont)* and the second is 55 feet above the base (unnamed). The *Verden Sandstone Lentil,* Pmv, is a coarse-grained, calcareous, fossiliferous sandstone (2 to 10 feet thick) that occurs in the middle of the Marlow, about 25 feet below the Relay Creek Bed and 85 to 95 feet above the base.

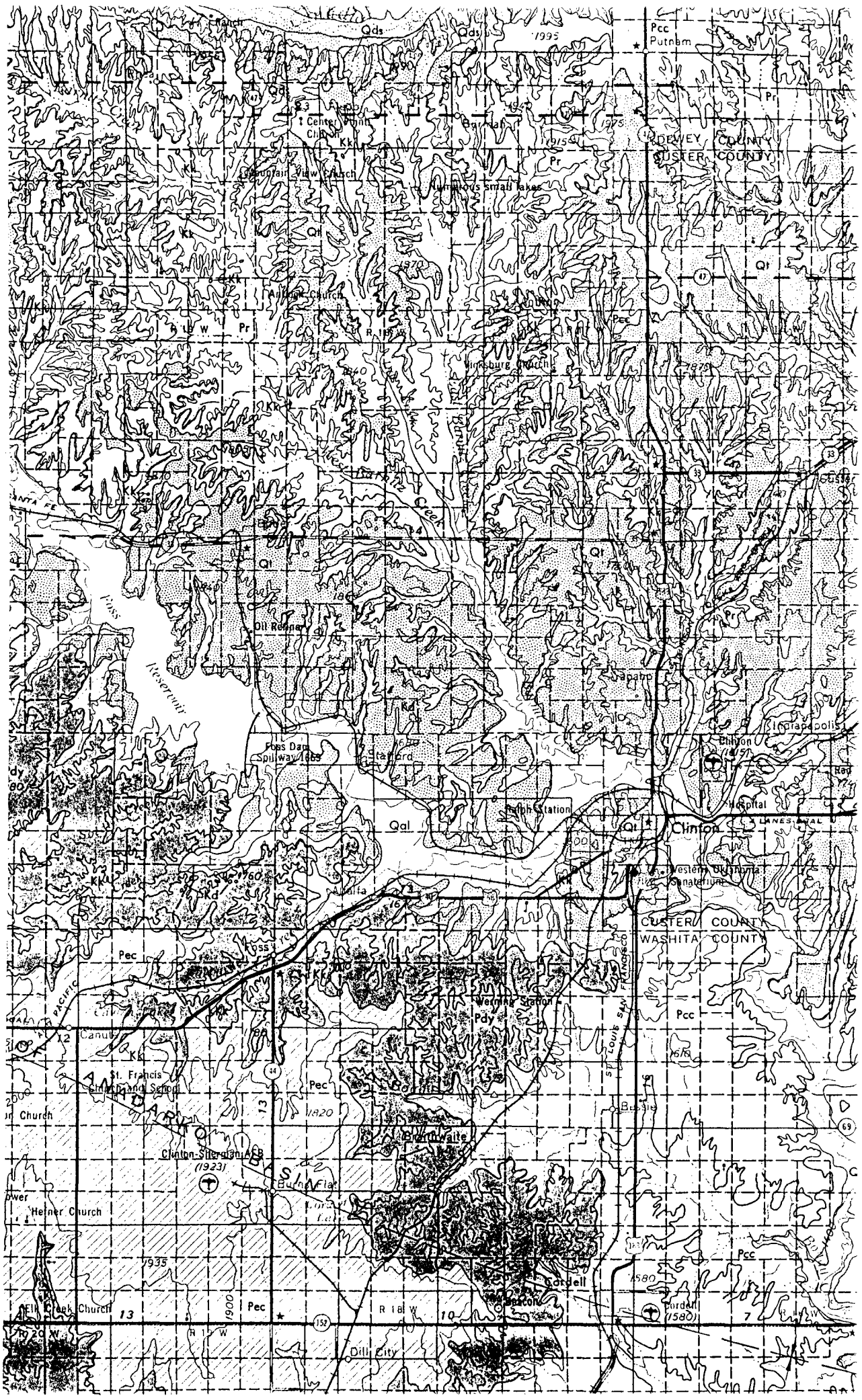


Figure 2. Geologic map.

EXPLANATION

Major Aquifers

Alluvium and terrace deposits

Along large streams, deposits consist of clay and silt at the surface, grading downward into coarse sand and gravel at the base. Water is available from saturated layers of sand and gravel, and yields are highest where the coarse sand and gravel layers are thickest. In areas where an alluvium or terrace aquifer overlies the Rush Springs Sandstone, water is available from either aquifer.

Ogallala Formation

Semiconsolidated layers of fine to medium sand, clay, silt, and gravel. Average thickness is probably about 100 feet.

Elk City Sandstone

Mainly fine-grained sandstone with minor amounts of silt and clay. Maximum thickness is about 185 feet; formation thins toward the edges.

Rush Springs Sandstone and Marlow Formation

The Rush Springs Sandstone, which has a maximum thickness of about 300 feet, consists mainly of fine-grained sandstone with some dolomite, shale, and gypsum beds. The Marlow Formation has a maximum thickness of about 100 feet and consists of fine-grained sandstone with much gypsum and shale.

Blaine Formation

Mainly shale, interbedded with gypsum and dolomite. Maximum thickness is about 200 feet. Water is available from erratically occurring solution channels in the gypsum.

Yield of Major Aquifers, Range in Gallons per Minute

More than 300

150 to 300

25 to 150

Yield of Remaining Areas, in Gallons per Minute

Generally less than 25

Note: Evaluation of yield areas assumes that drilled wells will be completed in aquifer's total thickness. Locally, individual wells in any of the areas shown on the map may yield more or less than is indicated for that area.

Area boundary; dashed where approximately located

U
Information unknown

e
Estimated yield

<
Well yield less than amount shown

288 / 56 / 730
Well

Upper number is depth of well, in feet; middle number is depth to water, in feet below land surface; lower number is yield of well, in gallons per minute. Where only two numbers are shown, they are well depth and depth to water; where only one number is shown, it is well depth.

6 / 53 / 12 / 350
Well field

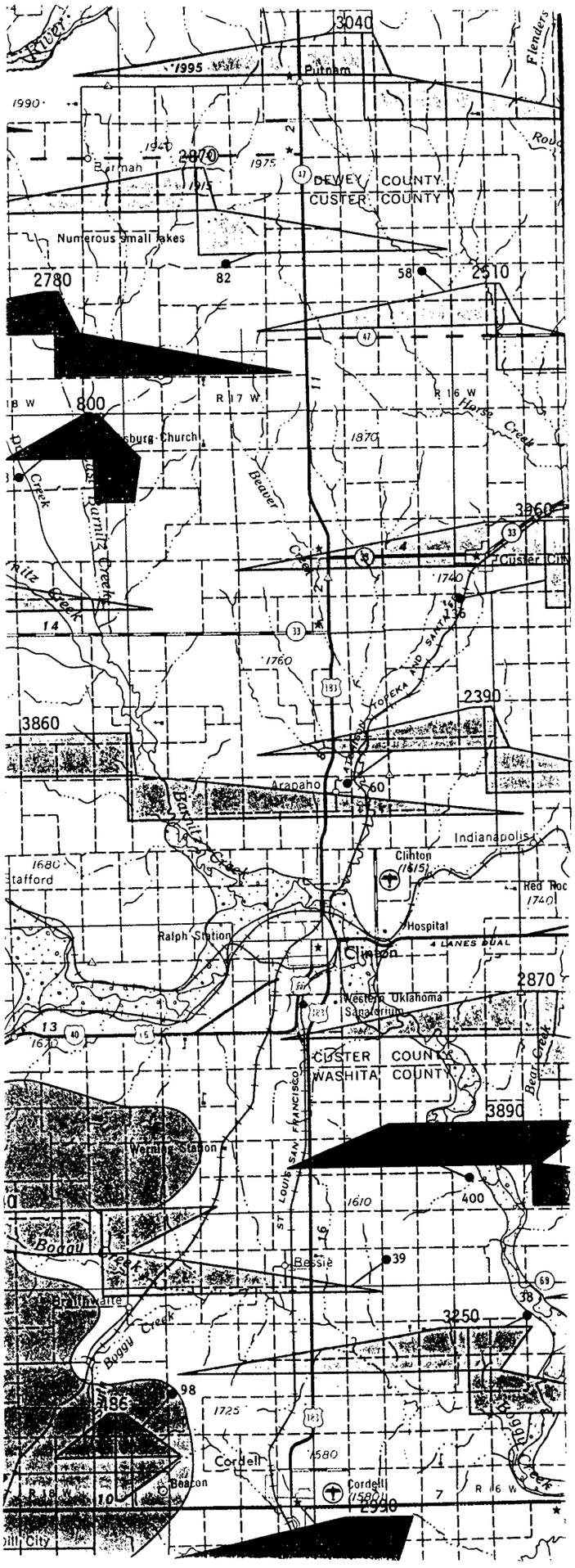
Upper number is number of wells in field; second number is average depth of wells, in feet; third number is average water level, in feet below land surface; fourth number is average well yield, in gallons per minute.

400 / 30
Flowing well

Upper number is depth of well, in feet; lower number is rate of flow, in gallons per minute.

5
Spring

Number beside spring symbol is yield in gallons per minute.



EXPLANATION

Chemical quality of water generally good

These areas generally yield water containing 500 mg/l (milligrams per liter) or less of dissolved solids, which is satisfactory for most uses. In a few local areas, dissolved solids may exceed 500 mg/l. The presence of an undesirable constituent or excessive hardness may make the water unsuitable for some purposes.

Chemical quality of water generally fair

These areas generally yield water containing 500 to 1,000 mg/l of dissolved solids, although in a few local areas dissolved solids may exceed 1,000 mg/l. The presence of an undesirable constituent or excessive hardness may make the water unsuitable for some purposes.

Chemical quality of water generally poor

These areas generally yield water containing more than 1,000 mg/l of dissolved solids. Excessive amounts of dissolved minerals limit the use of this water for most purposes.

Area boundary; dashed where approximately located

Source of Ground Water for Chemical-Quality Evaluation

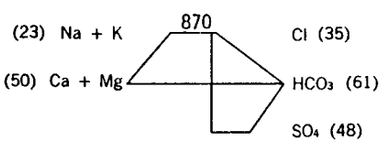
Alluvium and terrace deposits

Pattern indicates that source of ground water used in chemical-quality evaluation is alluvium and terrace deposits; absence of pattern generally indicates Ogallala and older formations as source. Note: alluvium and terrace deposits may overlie Ogallala and older formations in any area, but only one source is evaluated for chemical quality within a given area.

Water-Quality Diagrams

These diagrams show the general chemical character of ground water and are based on analyses of water samples from wells or springs at the indicated points. The size of a diagram is an indication of dissolved-solids content—the larger the area the greater the dissolved-solids content—and the numbers above the diagrams reflect the quantity of dissolved solids in milligrams per liter.

Variations in diagram's shape show variations in chemical character and in relative proportions of chemical constituents. Ionic concentrations are plotted for sodium plus potassium (Na + K), calcium plus magnesium (Ca + Mg), chloride (Cl), bicarbonate (HCO_3), and sulfate (SO_4). Anions (negatively charged ions) are plotted to the right of the center line, and cations (positively charged ions) are plotted to the left. The scale below can be used to read the value of milliequivalents per liter of a particular ion. Once the value is obtained in milliequivalents per liter, ionic concentrations can be converted to milligrams by using the factors given in parentheses (23, 50, 35, 61, and 48) beside the ions. The number derived by multiplying the appropriate factor by the milliequivalents per liter of the Cl, HCO_3, or SO_4 ion is the concentration as expressed in milligrams per liter, and the resulting number for Na + K is the concentration as Na. The resulting number for Ca + Mg is the hardness as $CaCO_3$.



● 60

Well from which water sample was collected; number indicates well depth, in feet

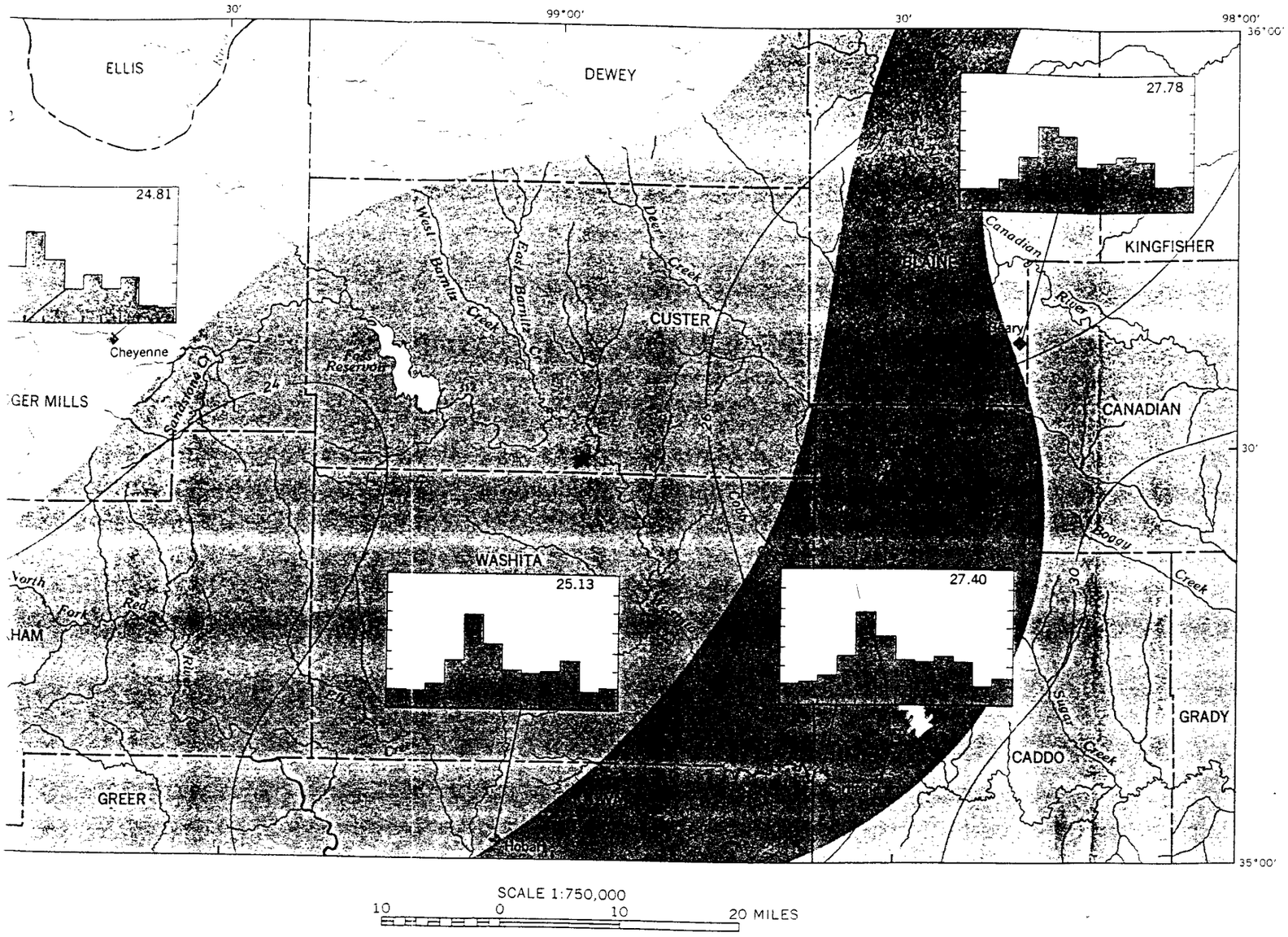


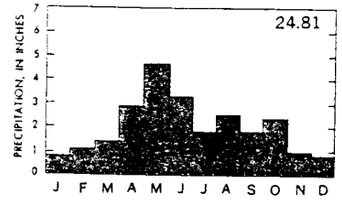
Figure 7. Map showing distribution of precipitation and runoff.

EXPLANATION

(Precipitation data from the National Oceanic and Atmospheric Administration)

24

Line of equal mean annual precipitation, in inches, based on normal annual precipitation, 1931–60



Graph of normal monthly precipitation

Figure in upper right of graph is normal annual precipitation, in inches

◆ Cheyenne
Weather station

Average yearly runoff, in inches

0.5 to 1.0

1.0 to 1.5

1.5 to 2.0

>2.0

REFERENCE 9

SITE SAFETY PLAN FOR RAY WICHERT PROPERTY SITE INVESTIGATION LEVEL D PERSONNEL PROTECTIVE EQUIPMENT OPERATIONS

The Ray Wichert Property (CERCLIS No. OKD987095049) is approximately 2 acres in size and occurs on an urban tract of land located in Custer County, Oklahoma. The legal description for the site is the SW/4, NE/4, NE/4, Section 27, T12N, R17W, and the coordinates are west longitude 98° 58' 41" and north latitude 35° 29' 24". There are several rubble piles located on-site that were from the Sooner Dial Company site, which was an airplane instrument dial refurbishing plant. The purpose of this sampling event is to determine if there is contaminated soil attributable to the rubble piles.

The entry objective is to collect 6 surface soil samples. The samples are anticipated to be of low concentration. Sampling is scheduled for April, 2000.

The site has been identified by the OES as a Type I site requiring Level D protective clothing. A Type I site is one at which there is no apparent hazard or at least no hazard posing an immediate danger to life and health. Specifically, it is a site at which:

(a) The wastes are in an unconfined area with good air circulation;
(b) There are no unknown odors or odors of known hazardous materials;
(c) There are no chemical disposal lagoons or leachate ponds, and surface water appears natural and clean;
(d) Plants and animals appear normal;
(e) There is visible or historical evidence of accessibility to humans without ill effects.

Such a site can be entered and visually appraised without use of respirators or skin protection. The contaminated soil and sediment at the site is in an open, well ventilated area which should not pose an immediate or delayed threat to respiratory organs or to exposed skin. No leachate ponds are present on the site. Level D clothing, which may include cotton coveralls, safety boots, safety glasses, hard hat, work gloves, and a Robertshaw escape mask, should provide adequate protection to workers on the site. The level of protection will be increased should conditions warrant additional respiratory or skin protection.

If the OES field team encounters unexpected chemical hazards, such as containers of unknown liquids or substances, it will evacuate the site, re-evaluate site conditions, increase the level of protection, then re-enter the site and attempt to identify the hazardous substance. If the OES field team determines that it cannot safely manage the hazardous substance, work on the site will be suspended until after the National Response Center has removed the hazardous material.

Control boundaries delineating an Exclusion Zone, Contamination Reduction Zone, and Support Zone will not be established on-site during the sampling activities because the Ray Wichert Property is a Type I site. A Gastech model GX-82 HS combustible gas/oxygen/hydrogen sulfide detector will be available on-site and will be used if unexpected chemical hazards are encountered or if buildings must be entered.

A map showing the boundaries of the site and the sampling locations is included with the site sampling plan.

A Site Emergency Route Map shows the route from the site to the nearest hospital, which is located 10 minutes away from the site in Clinton, Oklahoma. A first-aid kit, snake bite kit, and emergency eye wash will be provided to each sampling crew/vehicle on-site. The eye wash at the field base camp will be kept within arm's reach of the sample preservation station where nitric acid and sodium hydroxide are used. A cell phone or two-way radio will be provided to each sampling crew/vehicle for communication on-site.

Specific aspects of the site safety plan dealing with the OES medical program, health and safety training of OES personnel, standard operating procedures and safety practices at hazardous waste sites, and the development of specific site safety plans are covered in detail in Chapter 4 of the OES Quality Assurance Project Plan which is on file with the EPA/CERCLA Region 6 office in Dallas.

All OES field team members will review the site safety plan before work begins. Certain aspects of this plan may be modified by the OES Project Manager whenever warranted by on-site conditions.

CHEROKEE NATION OF OKLAHOMA
LEVEL D SITE SAFETY PLAN

A. SITE DESCRIPTION

DATE: April, 2000

LOCATION:

Ray Wichert Property: SW/4, NE/4, NE/4, Section 27, T12N, R17W, North Latitude 35° 29' 24" and West Longitude 98° 58' 41" in Custer County, Oklahoma.

HAZARDS:

Possible soil/sediment contamination.

WASTE CHARACTERISTICS/HAZARDS:

No apparent chemical hazards that are immediately dangerous to life and health.

PHYSICAL HAZARDS:

Concrete blocks, bricks, and rubble piles may present tripping hazard.

AREA AFFECTED:

Up to 2 acres

SURROUNDING POPULATION:

0 persons within 200 feet of the site; 1,341 people within 0-1 mile.

TOPOGRAPHY:

The Ray Wichert Property site lies in the Western Redbed Plains in the Anadarko Basin. This area is characterized by gently rolling hills of flat-lying red Permian sandstones and shales. Rock formations include Quaternary alluvium and terrace deposits that consists of stream-laid deposits of sand, silt, and clay; and the Cloud Chief Formation and Rush Springs Formation. These formations consist of shale, siltstone, and sandstone of Permian age.

WEATHER CONDITIONS:

The climate of Custer County is a warm, temperate climate. The temperature the day of sampling is expected to be 74° Fahrenheit. Average annual rainfall is 27.8 inches. About 80 percent of the rainfall occurs during the frost-free season from April to September. May is the wettest month and the driest is January.

ADDITIONAL INFORMATION:

The Oklahoma Bank and Trust Company of Clinton, OK has owned the property since 1987, although they are not the producers of the rubble piles located on-site. The site contains rubble from the Sooner Dial plant, which was an airplane instrument refurbishing plant located one mile from the site. The plant used radium-containing paint due to its luminous characteristics. Although sampling for radium contamination was performed in the past by the State of Oklahoma, a Site Investigation was not performed. The Cherokee Nation OES believes that there may be additional contamination from heavy metals or other chemicals on site that were used by the plant. Access to the site is unrestricted and heavy vegetation is present.

B. ENTRY OBJECTIVES

Collect 6 surface soil samples.

C. ON-SITE ORGANIZATION AND COORDINATION

Project Manager:	Kent Curtis
Assistant Project Manager:	Vacant
Field Team Leader:	Tom Elkins
Field Team Members:	Brad Asbill, Jason White, Randall Gee, Travis Waldo, Melinda Sims
Public Information Officer:	Tom Elkins
Tribal Representative:	
Landowner/Neighbors:	Oklahoma Bank and Trust Company
Contractors:	N/A

All personnel arriving or departing the site should log in and out with the Field Team Leader. All activities on site must be cleared through the Project Manager and/or Assistant Project Manager.

D. ON-SITE CONTROL

Brad Asbill has been designated to coordinate access control and security on-site.

The on-site Command Post and staging areas have been established at a meeting place at an abandoned parking lot 300 feet south of the rubble piles.

The prevailing wind conditions are: variable

Control boundaries have been established, and the Exclusion Zone (the contaminated area), hotline, Contamination Reduction Zone, and Support Zone (clean area) have been identified and designated as follows: Control boundaries will be established during sampling on the site only if the Project Manager and the Field Team Leader concur that certain site specific conditions (for example, waste sources within buildings, electrical or explosion hazards, leachate ponds) warrant the establishment of such boundaries. Such boundaries will be marked with fencing (when practical), yellow tape, and/or with signs. A map showing these boundaries will be included with this site safety plan, and a map showing the locations of sampling sites is included with the site sampling plan. These boundaries are identified by (describe): N/A

The on-site command post/field base camp will be established upwind of on-site waste sources or at a safe distance from such sources. When practical, the command post will be within sight of all parts of the site at which field sampling crews will be active. One or more OES field team members/leaders will be present at the command post at all times during field sampling activities and will maintain custody of all samples collected on-site. A cell phone and/or two way radio will be present at the command post along with a first aid kit, snake bite and insect bite kits, emergency eye wash, hand washing station, tool kit, a combustible gas/oxygen/hydrogen sulfide monitor, and, if necessary, other monitoring equipment (e.g., Geiger counter). Copies of the site safety plan will be at the command post and will be provided to each sampling crew/vehicle on site.

E. HAZARD EVALUATION

The following substance(s) are known or suspected to be on site. The primary hazards of each are identified.

Substances Involved	Concentrations (If Known)	Primary Hazards
organics/inorganics	low	physical

The following additional hazards are expected on site: N/A

Have hazardous substance information form(s) for the involved substance(s) been completed and attached: No

The following physical hazards are expected on site (describe):

Rubble piles may present tripping hazard.

F. PERSONAL PROTECTIVE EQUIPMENT

Based on evaluation of potential hazards, the following levels of personal protection have been designated for the applicable work areas or tasks:

Location	Job Function	Level of Protection
Exclusion Zone	Collect samples	A B C **D** Other
Contamination	Decontaminate	A B C **D** Other
Reduction Zone	sampling equipment	A B C **D** Other

Specific protective equipment for each level of protection is as follows:

Level A	Level C
Fully-encapsulating suit	Splash gear (type) &
SCBA	Tyvek suits
(disposable overalls)	Full-face canister respirator
	boots & boot covers
	hard hat
	protective gloves (2 pairs)

Level B	Level D
Splash gear (type)	tyvek suits
Nomex inflammable coveralls or	protective boots & covers
100% cotton coveralls	safety glasses (clear lens)
SCBA	hard hat
	protective gloves
	Robert Shaw Escape Mask

In certain site specific situations, with the approval of the OES Project Manager and the OES Field Team Leader, OES personnel may use modified Level C (tyvek suits in place of splash gear) or modified Level D (use of only protective boots and gloves, without tyvek suits, hard hat, and glasses) during on-site activities.

OES safety glasses will provide front and side protection and will have clear lenses that will not interfere with the perception of colors. Protective gloves may be silvershield, nomex, or vinyl.

The following protective clothing materials are required for the involved substances at this site:

Substance	Material
Organics/inorganics	protective g l o v e s

If air-purifying respirators are authorized, Wilson T45 Combination Cartridges are the appropriate canister for use with the involved substances and concentrations. A competent OES individual has determined that all criteria (OSHA PELs) for using this type of respiratory protection have been met and that all OES personnel who will wear respirators during on-site activities have been properly fit tested with full-face canister respirators.

NO CHANGES TO THE SPECIFIED LEVELS OF PROTECTION SHALL BE MADE WITHOUT THE APPROVAL OF THE FIELD TEAM LEADER AND THE PROJECT MANAGER AND/OR ASSISTANT PROJECT MANAGER.

G. ON-SITE WORK PLANS

Work party(s) consisting of 2 or 3 persons will perform the following tasks:

Field Team Leader:	Tom Elkins Jason White	Support & Decontamination Zones
Work Party #1:	Melinda Sims Brad Asbill	Sampling
Work Party #2:	Travis Waldo Randall Gee	Sampling

Other:

*Rescue Team:	Field Team Leaders or one of the work parties

*(required for entries to IDLH environments)

Procedure for handling any hazardous wastes encountered: Evacuate site, evaluate level of personnel protection, re-enter site to identify waste; call National Response Center if conditions warrant.

The work party(s) were briefed on the contents of this plan: YES .

H. COMMUNICATION PROCEDURES

A cell phone and/or two-way radio is provided to each field sampling team/vehicle on site. Each team/vehicle must be provided with the cell phone numbers of all other teams/vehicles. When radios are used, channel 1 has been designated as the Tribal radio frequency for personnel in the Exclusion Zone. All other onsite communications will use channel 2.

Personnel working in the Exclusion Zone in Levels A, B, or C personal protective equipment should remain in constant telephone/radio communication or within sight of the Project Team Leader. Any failure of telephone/radio communication requires an evaluation of whether personnel should leave the Exclusion Zone. Personnel working in the Exclusion Zone in Level D personal protective equipment need not be in constant communication with the Project Team Leader but must have quick access to telephone, radio, and/or visual communication with the Project Team Leader.

Verbal warning or four blasts of a vehicle horn are the emergency signals to indicate that all personnel should leave the Exclusion Zone.

The following standard hand signals will be used in case of failure of radio communications:

Hand gripping throat	Out of air, can't breathe
Grip partner's wrist or both hands around waist	Leave area immediately
Hands on top of head	Need assistance
Thumbs up	OK, I am all right, I understand
Thumbs down	No, negative

Telephone communication to the Command Post should be established as soon as practicable. The telephone number is (check one): 453-7434 ___; 453-7441 ___; 453-7475 ___; 453-7497 ___; other _____ .

I. DECONTAMINATION PROCEDURES

Personnel and equipment leaving the Exclusion Zone shall be thoroughly decontaminated. The standard level 4 decontamination protocol shall be used with the following decontamination stations: (1)_____ (2)_____ (3)_____ (OTHER) The work parties leaving the exclusion zone or sampling areas will remove their protective gloves, tyvek suits, and other single-use-only personal protective equipment and dispose of these items in the decontamination zone. Also, the sampling equipment will be decontaminated in the decontamination zone. When necessary, a Decontamination Zone crew of 2 to 3 persons will be assigned to assist crews entering and leaving the exclusion zone with the donning, doffing, and decontamination of personal protective equipment, sampling equipment, and sample bottles.

Emergency decontamination will include the following stations:

An initial wash with liquinox detergent in deionized/HPLC grade water and two subsequent rinses with deionized/HPLC grade water.

The following decontamination of equipment is required:

Field team members will wash equipment, etc., with Liquinox detergent and deionized/HPLC grade water, using an initial wash with detergent in water and two subsequent rinses with water only.

Procedures for disposing of decontamination solutions and non-reusable sampling equipment:

When the used decontamination and rinse solutions are believed to contain medium to high concentrations of contaminants, they will be collected in 10-gallon or 55-gallon drums for proper labeling, short-term (less than one year) storage at OES or Cherokee Nation facilities in

Tahlequah, and eventual disposal in accordance with RCRA and DOT regulations. An equipment blank sample of the combined decontamination and rinse solutions will be collected at the end of sampling operations on-site. Analysis of this sample will document the contaminant concentrations of the combined decontamination and rinse solutions and facilitate proper labeling and disposal of the 10-gallon or 55-gallon drums.

When the used decontamination solutions are believed to contain low concentrations of contaminants, the solutions and rinses will not be collected but will be poured onto the ground on-site. (Sample data obtained from 48 Site Investigations conducted by OES since 1992 indicate that this method of disposal is safe.) Immediately prior to disposal the decontamination and rinse solutions will be combined, then a final equipment blank sample of the combined solutions will be collected. Analysis of this sample is intended to document the low concentrations of any contaminants in the combined solutions.

Non-reusable sampling equipment (protective gloves, tyvek suits, towels, etc.) that are believed to have low-level contamination will be placed in heavy duty trash bags for household trash disposal. (Sample data obtained from 48 Site Investigations conducted by OES since 1992 indicate that this method of disposal is safe.) If such non-reusable equipment is believed to have medium to high-level contamination, it will be sealed in 55-gallon drums for proper labeling, short-term (less than one year) storage at OES or Cherokee Nation facilities in Tahlequah, and eventual disposal in accordance with RCRA and DOT regulations.

Other site specific disposal procedures (describe):

J. SITE SAFETY AND HEALTH PLAN

1. Tom Elkins will be the designated Field Team Leader and is directly responsible for safety recommendations on-site.

2. Emergency Medical Care

A qualified EMT is not on site. A qualified First Responder is not on site. In the event of an emergency, the local ambulance service and hospital will be contacted as outlined below.

Clinton Regional Hospital, in Clinton, Oklahoma, phone (580) 323 - 8353 is located 10 minutes from the site. The hospital was not contacted and briefed about the on-site situation, the potential hazards, and the substances involved. A map of emergency route(s) to this facility is attached as the last page of this site health and safety plan.

Local ambulance service is available from Clinton, Oklahoma at telephone number 911 or (580) 323 - 1978. Their response time is 6 minutes. Whenever possible, arrangements should be made for on-site standby.

First-aid equipment is available on site at the following locations:

First-aid, snake bite, & insect bite kits	Command post & each field truck
Emergency eye wash	Command post & each field truck
Emergency shower	N/A

Emergency medical information for substances present:

SUBSTANCE	EXPOSURE SYMPTOMS	FIRST-AID INSTRUCTIONS
Inorganic/organic	general	general

Material Safety Data Sheets (MSDS) or other information sheets (from ATSDR, NIOSH, etc.) for the substances listed in the table above are attached to this site health and safety plan. Additional references (e.g., NIOSH Pocket Guide to Chemical Hazards) will be at the Command Post on site.

List of emergency phone numbers:

AGENCY/FACILITY	PHONE NUMBER	CONTACT PERSON
Ambulance	911 or (580) 323 - 1978	
Civil Defense		
Custer County Sheriff	1-800-894-2677	
Fire Department	911 or (580) 323-1313	
Hospital (Clinton)	(580) 323 - 8353	Clinton Regional Hospital
Poison Control	1-800-522-4611	
Toxic Chemical	1-800-424-8802	
Highway Patrol (Clinton)	(580) 323-2424	
Police (Clinton)	911 or (580) 323-2323	
U.S. Marshall Service		
Gas Company		
Electric Cooperative		
Water Plant		
Communities		
Towns		
Roads		
Highway Department		
Railroads		
Local Emergency Planning Committee		
Other		
Cherokee Nation	918-456-0671	
State Health Department		
National Response Center	1-800-424-8802	
Cherokee Superfund	918-458-5496	

3. Environmental Monitoring

The following environmental monitoring instruments shall be used on-site (cross out if not applicable) at the specified intervals.

Combustible Gas Indicator	- continuous/hourly/daily/other <u>if necessary</u>
0_2 Monitor	- continuous/hourly/daily/other <u>if necessary</u>
Hydrogen sulfide monitor	- continuous/hourly/daily/other <u>if necessary</u>
Colorimetric Tubes	- continuous/hourly/daily/other _____
_____	_____
_____	_____
_____	_____
HNU/OVA	- continuous/hourly/daily/other _____
Other: _____	- continuous/hourly daily/other _____
_____	- continuous/hourly/daily/other _____

4. Emergency Procedures (should be modified as required for incident)

The following standard emergency procedures will be used by on-site personnel. The Project Manager and/or Assistant Project Manager shall be notified of any on-site emergencies and be responsible for ensuring that the appropriate procedures are followed.

<u>Personnel Injury in the Exclusion Zone</u>: Upon notification of an injury in the Exclusion Zone, the designated emergency signal <u>four blasts on vehicle horn or verbal alert</u> shall be sounded. All site personnel shall assemble at the decontamination line. The rescue team will enter the Exclusion Zone (if required) to remove the injured person to the hotline. The Field Team Leader and Assistant Project Manager should evaluate the nature of the injury, and the affected person should be decontaminated to the extent possible prior to movement to the Support Zone. The on-site EMT and/or First Responder shall initiate the appropriate first aid, and contact should be made for an ambulance and with the designated medical facility (if required). No persons shall re-enter the Exclusion Zone until the cause of the injury or symptoms is determined.

<u>Personnel Injury in the Support Zone</u>: Upon notification of an injury in the Support Zone, the Project Manager/Assistant Project Manager and Field Team Leader will assess the nature of the injury. If the cause of the injury or loss of the injured person does not affect the performance of site personnel, operations may continue, with the on-site EMT and/or First Responder initiating the appropriate first aid and necessary follow-up as stated above. If the injury increases the risk to others, the designated emergency signal <u>four blasts on vehicle horn or verbal alert</u> shall be sounded and all site personnel shall move to the decontamination line for further instructions. Activities on-site will stop until the added risk is removed or minimized.

Fire/Explosion: Upon notification of a fire or explosion on-site, the designated emergency signal four blasts on vehicle horn or verbal alert shall be sounded and all site personnel assembled at the decontamination line. The fire department shall be alerted and all personnel moved to a safe distance from the involved area.

Personal Protective Equipment Failure: If any site worker experiences a failure or alteration of protective equipment that affects the protection factor, that person and his/her buddy shall immediately leave the Exclusion Zone. Re-entry shall not be permitted until the equipment has been repaired or replaced.

Other Equipment Failure: If any other equipment on-site fails to operate properly, the Project Manager/Assistant Project Manager and Field Team Leader shall be notified and then determine the effect of this failure on continuing operations on-site. If the failure affects the safety of personnel or prevents completion of the Work Plan tasks, all personnel shall leave the Exclusion Zone until the situation is evaluated and appropriate actions taken.

The following emergency escape routes are designated for use in those situations where egress from the Exclusion Zone cannot occur through the decontamination line (describe): Unrestricted exit routes in all directions.

In all situations, when an on-site emergency results in evacuation of the Exclusion Zone, personnel shall not re-enter until:

1. The conditions resulting in the emergency have been corrected.
2. The hazards have been reassessed.
3. The Site Safety Plan has been reviewed.
4. Site personnel have been briefed on any changes in the Site Safety Plan.

5. Personal Monitoring

The following personal monitoring will be in effect on site:

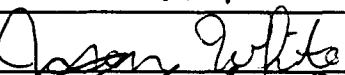
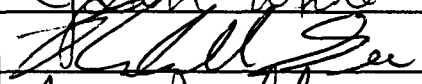
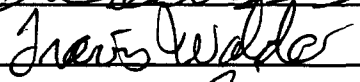
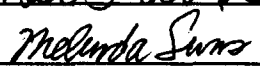
Personal exposure sampling: None

Medical monitoring: The expected air temperature will be 74° F. If it is determined that heat stress monitoring is required (mandatory if over 70 degrees Fahrenheit) the following procedures shall be followed (describe): Sufficient drinking water and rest breaks will be provided. Level D clothing reduces probability that heat stress will occur.

6. Special site equipment, facilities, or procedures (sanitary facilities, lighting, etc.):

NONE

All site personnel have read the above plan and are familiar with its provisions.

TITLE	NAME	SIGNATURE
Field Team Leader		
Field Team Leader, Public Information Officer	Tom Elkins	
Field Team Member (FTM)	Brad Asbill	
FTM	Jason White	
FTM	Randall Gee	
FTM	Travis Waldo	
FTM	Melinda Sims	
FTM		
FTM		
FTM		
FTM		
FTM		
FTM		
FTM		

INTER-TRIBAL ENVIRONMENTAL COUNCIL

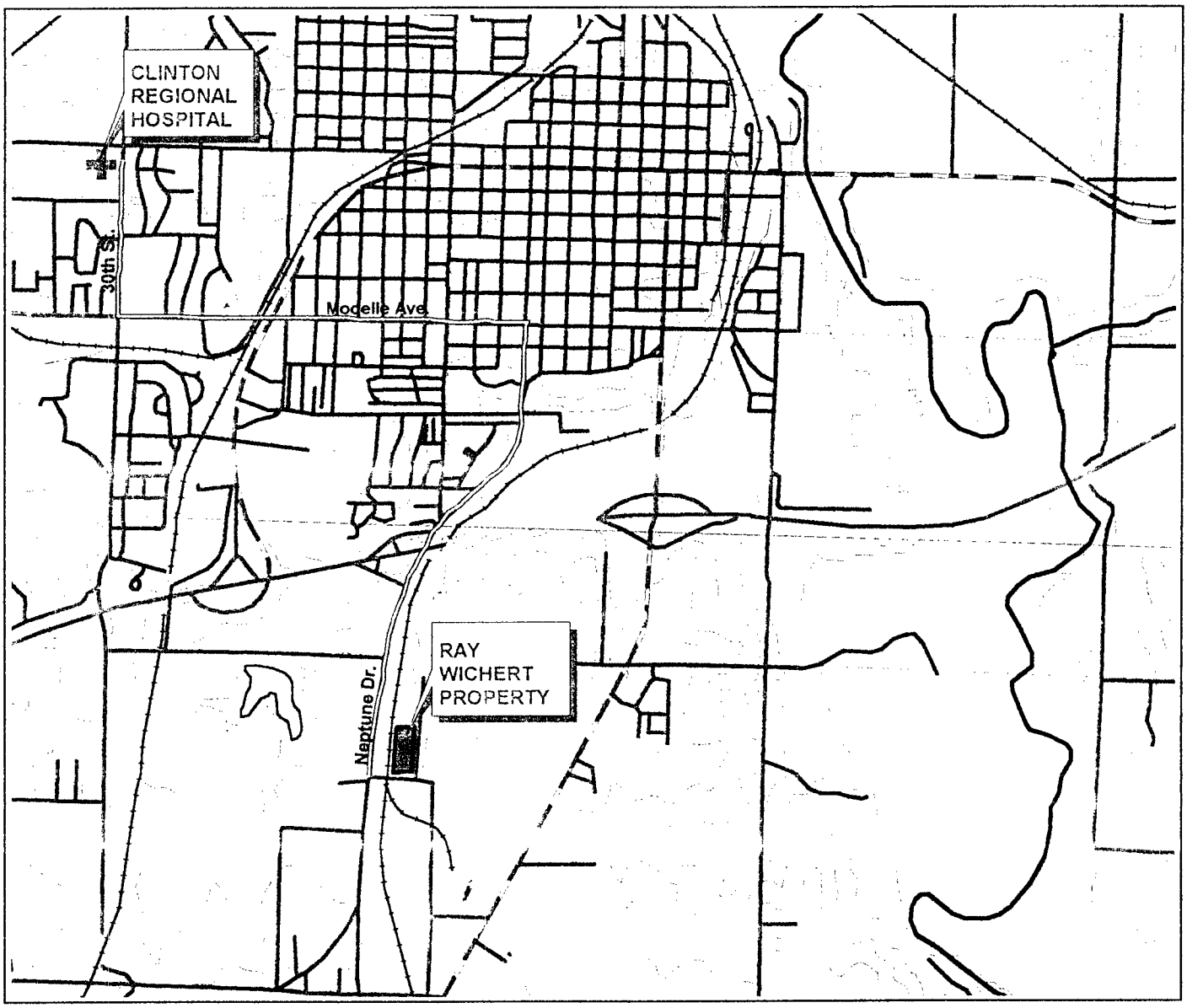
CHEROKEE NATION OF OKLAHOMA
OFFICE OF ENVIRONMENTAL SERVICES
TAHLEQUAH, OKLAHOMA

RAY WICHERT PROPERTY

SITE INVESTIGATION - EMERGENCY ROUTE MAP
USGS 7.5 MINUTE QUADRANGLES
BESSIE, OK AND CLINTON, OK
SECTION 27, T12N, R17W - CUSTER COUNTY

FIGURE 2

DATE
APRIL 2000



DIRECTIONS

From site, drive 1.5 miles north on Neptune Drive, then 1.25 miles west on Modelle Ave., then .5 miles north on 30th street. Hospital is on west side of 30th street.

HOSPITAL

Clinton Regional Hospital
100 North 30th Street
Clinton, OK 73601
(580) 323-2363

0 0.5 1

Scale in Miles

N

RAY WICHERT PROPERTY

Sample Location Number	Sample Matrix	Type Sample
1	Surface Soil, low concentration	Judgmental Grab
2	Surface Soil, low concentration, duplicate of 1	Judgmental Grab
3	Surface Soil, low concentration	Judgmental Grab
4	Surface Soil, low concentration	Judgmental Grab
5	Surface Soil, low concentration	Judgmental Grab
6	Surface Soil, low concentration, background	Judgmental Grab
7	Equipment blank, initial rinsate	deionized/HPLC H2O
8	Equipment blank, final rinsate	deionized/HPLC H2O
9	Field blank	deionized/HPLC H2O
10	Trip Blank, VOA only	deionized/HPLC H2O

SAMPLE NUMBER	SAMPLE LOCATION AND RATIONALE
1	Soil (0-6 inches). Low concentration grab sample collected around the rubble piles. Rationale: Identify a contaminated area and determine if there is contaminated soil attributable to the rubble piles.
2	Soil (0-6 inches). Low concentration grab sample collected around the rubble piles. Rationale: Duplicate of sample number 1. Assess the CLP sampling and measurement error, quality control sample.
3	Soil (0-6 inches). Low concentration grab sample collected around the rubble piles. Rationale: Identify a contaminated area and determine if there is contaminated soil attributable to the rubble piles.
4	Soil (0-6 inches). Low concentration grab sample collected around the rubble piles. Rationale: Identify a contaminated area and determine if there is contaminated soil attributable to the rubble piles.

5 Soil (0-6 inches). Low concentration grab sample collected around the rubble piles.
Rationale: Identify a contaminated area and determine if there is contaminated soil attributable to the rubble piles.

6 Soil (0-6 inches). Low concentration grab sample collected two miles northeast of the site.
Rationale: Establish a background baseline for comparison to the low concentration soil samples.

7 Eqipment blank. Initial rinsate from the soil/sediment sampling equipment decontamination process, utilizing deionized/HPLC grade water.
Rationle: Quality control sample. Identify any contamination introduced during the decontamination of sampling equipment.

8 Equipment blank. Final rinsate, grab sample collected on-site after all other samples have been collected and all sampling equipment has been decontaminated in liquinox detergent and deionized/HPLC grade water.
Rationale: Quality control sample. Quantify contaminant concentrations in combined wash and rinsate solutions.

9 Field blank, deionized/HPLC-grade water.
Rationale: Quality control sample. Identify any contamination introduced during the on-site sample collection and storage.

10 Trip blank, VOA only, deionized/HPLC - grade water.
Rationale: Quality control sample. Identify any volatile organic contamination introduced during the sample handling, storage, and transport.

INTER-TRIBAL ENVIRONMENTAL COUNCIL

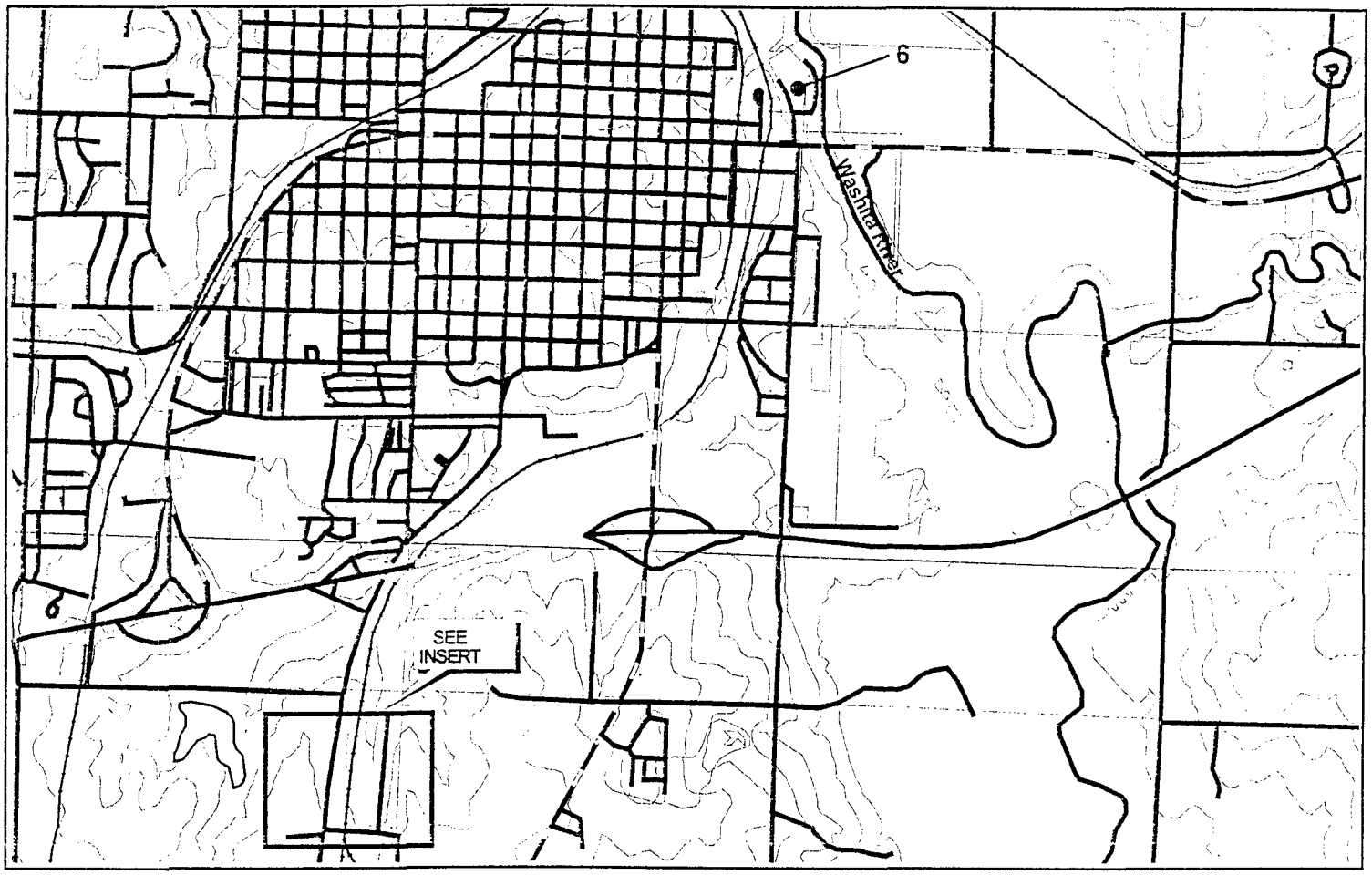
CHEROKEE NATION OF OKLAHOMA
OFFICE OF ENVIRONMENTAL SERVICES
TAHLEQUAH, OKLAHOMA

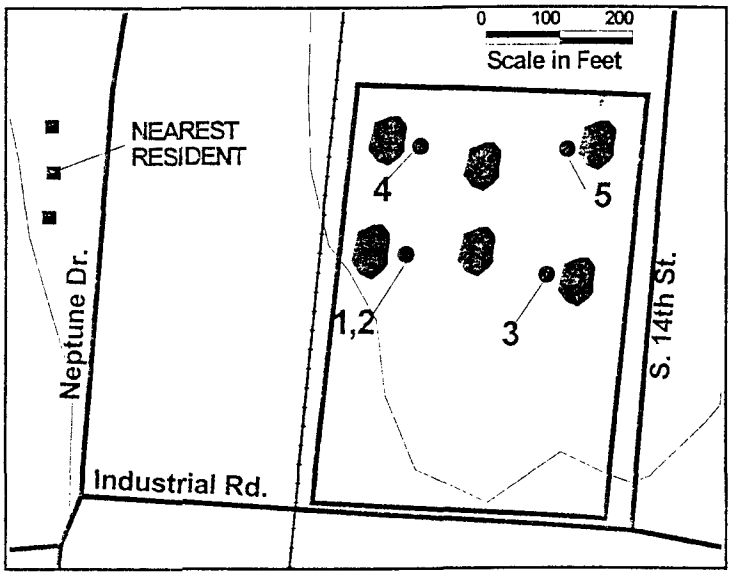
RAY WICHERT PROPERTY

SITE INVESTIGATION - SAMPLE PLAN
USGS 7.5 MINUTE QUADRANGLES
CLINTON, OK AND BESSIE, OK
SECTION 27, T12N, R17W-CUSTER COUNTY

FIGURE 1

DATE
APRIL 2000





LEGEND

- Rubble Piles
- Soil Sample Location
- Site: Ray Wichert Property

0 0.2 0.4 0.6 0.8 1
Scale in Miles

N

REFERENCE 10

Practical Handbook of Ground-Water Monitoring

Edited by

David M. Nielsen

LEWIS PUBLISHERS

Practical handbook of ground-water monitoring/David M. Nielsen, editor.

p. cm.
Includes bibliographical references and index.
1. Water, Underground—Quality—Measurement. I. Nielsen, David.

TD426P73 1991 628.1'61—dc20 90-36848
ISBN 0-87371-124-6

Second Printing, 1991

LEWIS PUBLISHERS, INC.
121 South Main Street, Chelsea, MI 48118

PRINTED IN THE UNITED STATES OF AMERICA

PREFACE

Ground-water monitoring is by no means a new field because hydrogeologists, engineers, and other professionals have been monitoring ground water for decades. Yet, much of the technology used today to perform such basic tasks as water-level measurement, water-quality characterization, and aquifer tests is less than a decade old. Indeed, the decade of the 1980s was a period of explosive growth for the field of ground-water monitoring, and a time of great achievement for those involved in conducting ground-water investigations. During this time, we developed a basic understanding of how our ground-water resources were being impacted by many of our everyday activities, what we needed to do to prevent further degradation, and how we could clean up ground water that had already been detrimentally impacted.

Passage of the Resource Conservation and Recovery Act (RCRA) by Congress in 1976 and subsequent promulgation of the first of the regulations authorized under RCRA by the U.S. Environmental Protection Agency (EPA) in May 1980 provided the primary impetus for the growth of the field of ground-water monitoring. RCRA, which is EPA's main tool for managing hazardous waste from generation through disposal, included provisions for establishing ground-water or vadose-zone monitoring systems at all of this country's hazardous waste treatment, storage, and disposal facilities, which include hundreds of thousands of sites. More recent provisions of RCRA specify similar monitoring systems for each of the country's solid waste landfill facilities (sanitary landfills), which number in the thousands. Still other provisions of recent amendments to RCRA (the Hazardous and Solid Waste Amendments of 1986) call for the installation of ground-water or vadose-zone monitoring systems at many underground storage tank locations, which number in the hundreds of thousands across the country.

Passage of the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA), better known as "Superfund," by Congress in December 1980 addressed the national threat caused by so-called "uncontrolled" hazardous waste sites, which probably number in the tens of thousands. Cleanup of these sites requires the installation of monitoring devices to investigate the extent of environmental contamination and to monitor the progress of the cleanup. Ground-water monitoring is also done under other environmental regulatory programs, and for a variety of nonregulatory purposes, creating a tremendous demand for knowledge in this field.

Like most fields that experience such tremendous surges in growth, the ground-water monitoring field, if it can truly be called that, has seen periods of disorder

The porosity used in Equation 10.8 is the effective porosity, $\bar{n}$, which always has a lower value than the total porosity. Some water in pore spaces may be held onto soil particles by molecular binding forces (Mitchell, 1976). The soil may contain dead-end pores or unconnected pores which contain water, but through which no water flow is occurring. Therefore, caution should be exercised in selecting effective porosities. Effective porosity is difficult to measure and is typically selected by intuition or experience. Tracer experiments can be used to estimate effective porosities but the procedure is fraught with difficulties. When porosity is very low, laboratory errors may become significant. Field variation in porosity, however, may exceed laboratory errors and suggests multiple in situ test sites.

HYDRAULIC CONDUCTIVITY AND PERMEABILITY

The rate of water movement through a soil was first described mathematically by Darcy (1856). By studying the flow of water through sand columns, Darcy developed a relationship between the filtration velocity, the hydraulic gradient, and a coefficient, K, which has come to be known as the hydraulic conductivity. K is a function of both the medium through which the fluid is moving, and of the fluid itself. In many engineering texts, K is also known as the coefficient of permeability. As a result, the two terms are used interchangeably in hydrogeologic applications. Hydraulic conductivity is expressed in units of length per time, such as meters per second (m/s) or feet per day (ft/day).

Another term, intrinsic permeability, k, is used to describe the part of K that depends only on the medium in which a fluid is flowing. Intrinsic permeability has the units of length squared, such as cm^2 or mm^2, or the darcy ($0.987 \times 10^{-12} m^2$ = 1 darcy).

For granular porous media, Darcy's law can be written as:

$$v_s = Ki \tag{10.9}$$

where:

v_s = specific discharge in units of length per time,
K = the hydraulic conductivity in units of length per time, and
i = dimensionless hydraulic gradient in the direction of v_s.

This definition has been modified to describe flow in a fracture (Louis, 1974). Table 10.4 presents typical hydraulic conductivity values for various geologic materials. Generally, the finer the soil particle size, the lower the hydraulic conductivity value. The difference in K ranges between silts or clays and sands is a result of the smaller effective pore sizes in clays and silts than in sands. Soils which contain a broad range of grain sizes, such as a glacial till, typically have lower K values than a uniformly sized soil, such as a beach sand. Darcy's law

Table 10.4. Typical Hydraulic Conductivities.

Geologic Material	Range of K (m/s)
Coarse gravels	10^{-1}–10^{-2}
Sands and gravels	10^{-2}–10^{-5}
Fine sands, silts, loess	10^{-5}–10^{-9}
Clay, shale, glacial till	10^{-5}–10^{-13}
Dolomitic limestones	10^{-3}–10^{-5}
Weathered chalk	10^{-3}–10^{-5}
Unweathered chalk	10^{-6}–10^{-9}
Limestone	10^{-3}–10^{-9}
Sandstone	10^{-4}–10^{-10}
Unweathered granite, gneiss, compact basalt	10^{-7}–10^{-13}

is the cornerstone for evaluating ground-water flow behavior. However, the relationship is valid only as long as the velocity remains within a particular range of values. As the hydraulic gradient is increased, the water velocity increases and friction loss within the pores or fractures correspondingly increases. This phenomenon is analogous to flow through a pipe. Above a critical velocity, frictional losses are no longer linearly related to i, and Darcy's law must be modified or it becomes invalid. Some authors have suggested that an upper limit to the applicability of Darcy's equation for porous media be established by relating the velocity to a Reynold's Number (Bear, 1972). Reynold's Number for a porous medium can be defined as:

$$R_e = \bar{v} d \rho / \mu \tag{10.10}$$

where:

$\bar{v}$ = mean velocity of water in pores in units of length per time,
ρ = fluid unit density in units of mass per volume,
μ = the viscosity of the fluid in units of mass per time-length, and
d = mean diameter of the pores as estimated from the effective grain size diameter in units of length.

In porous media, d is typically selected as the particle size for which 10% of the sample is smaller. In fractured media, d becomes the fracture width. Darcy's law is considered valid up to an R_e of between 1 and 10. Between an R_e of 10 to 100, turbulent flow begins, and beyond 100, turbulence predominates and Darcy's law is invalid.

There also appears to be evidence, although some is conflicting, that for clay or other fine-grained materials Darcy's law may be invalid for very low gradients (Jacquin, 1965a, b). Desaulniers et al. (1986) performed a field investigation in a thick clayey glacial till that supports the concept of threshold gradients. A relationship for Darcy's law incorporating a threshold gradient is suggested as shown

REFERENCE 11

WASHITA NATIONAL WILDLIFE REFUGE

FOSS LAKE

FOSS STATE PARK

STAFFORD

ARAPAHO POP. 802

CLINTON POP. 9,298

CLINTON-MUNICIPAL AIRPORT

INDIANOLA

WASHITA RIVER

FARMRAIL

ALFALFA Creek

PARKERSBURG

KOLB LANDING STRIP

TO ELK CITY

TO FOSS

TO CORDELL

TEXAS

R 20 W | R 19 W | R 18 W | R 17 W | R 16 W | R 15 W

W A S H I T A C O U N T Y

NS 209 | NS 215 | NS 221 | NS 227 | NS 233

1,600,000 FEET

99°15'00" | 99°00'00"

STAFFORD, OKLAHOMA
SEC. 8, T12N, R18W
SCALE
0 0.1 0.2 0.3 0.4 0.5 MILE
660' 1,320' 2,640' FEET

MOOREWOOD, OKLAHOMA
SEC. 29, T15N, R20W
SCALE
MILE 0 0.1 0.2 0.3 0.4 0.5 0.6 0.7 0.8 0.9 1.0
FEET 0 1,320 2,640' 5,280'

LEGEND

- U.S. NUMBERED HIGHWAY
- STATE NUMBERED HIGHWAY
- INTERSTATE HIGHWAY ROUTE
- PAVED ROAD
- GRAVEL ROAD
- GRADED & DRAINED ROAD
- UNIMPROVED ROAD
- PRIMITIVE ROAD
- PROJECTED ROAD
- RESIDENTIAL ROAD
- N0001 COUNTY ROAD ID NO.
- MILEAGE BETWEEN POINTS
- DIVIDED HIGHWAY, 4 OR MORE LANES
- UNDIVIDED HIGHWAY, 3 OR MORE LANES
- TRAFFIC CIRCLE
- HIGHWAY GRADE SEPARATION
- TRAFFIC INTERCHANGE
- STATE LINE
- COUNTY LINE
- CIVIL TOWNSHIP LINE
- SECTION LINE
- RURAL DEVELOPMENT AREA
- GOVERNMENT PROPERTY LINE
- MATCH LINE
- COUNTY SEAT
- TOWN CENTER
- CORPORATE LIMITS
- CIVIL TOWNSHIP ROAD IN PLACE
- INSET BOUNDARY

- RAILROAD, ANY NUMBER OF TRACKS
- RAILROAD WITH STATIONS INDICATED
- GRADE CROSSING
- UNDERPASS, R.R. ABOVE
- OVERPASS, R.R. BELOW
- RAILROAD ON STREET
- MILITARY AIRFIELD
- AIRPORT WITH COMPLETE
- AIRPORT WITH LIMITED F
- LANDING STRIP, PRIVATE
- AIRPORT, GENERAL OUTL RUNWAYS SHOWN IN PO
- ROADSIDE PARK, Picnic G PLAYGROUNDS, BATHING BEACH OR SWI
- SCENIC SITE
- MOTEL
- CAMP OR LODGE, Permar SP-State, CF
- SMALL PARK MP-Municipa
- FOREST RANGER STATIO
- OBSERVATION OR LOOK
- CAMP SITE
- FISH HATCHERY
- GOLF COURSE OR COUN
- ATHLETIC FIELD OR AMU
- FAIRGROUNDS, RACE CO
- DWELLING
- NUMBER OF DWELLINGS COMBINED BUSINESS AN
- POST OFFICE
- POST OFFICE COMBINAT

ALL DATA CURRENT TO DATE OF INVENTORY APRIL, 1987

ORIGINAL DRAFTING BY L.R.K. JUNE, 1989
STATE SYSTEM REVISED TO JAN., 1995

N

GENERAL HIGHWAY MAP

CUSTER COUNTY

OKLAHOMA

PREPARED BY THE
OKLAHOMA DEPARTMENT OF TRANSPORTATION
PLANNING DIVISION

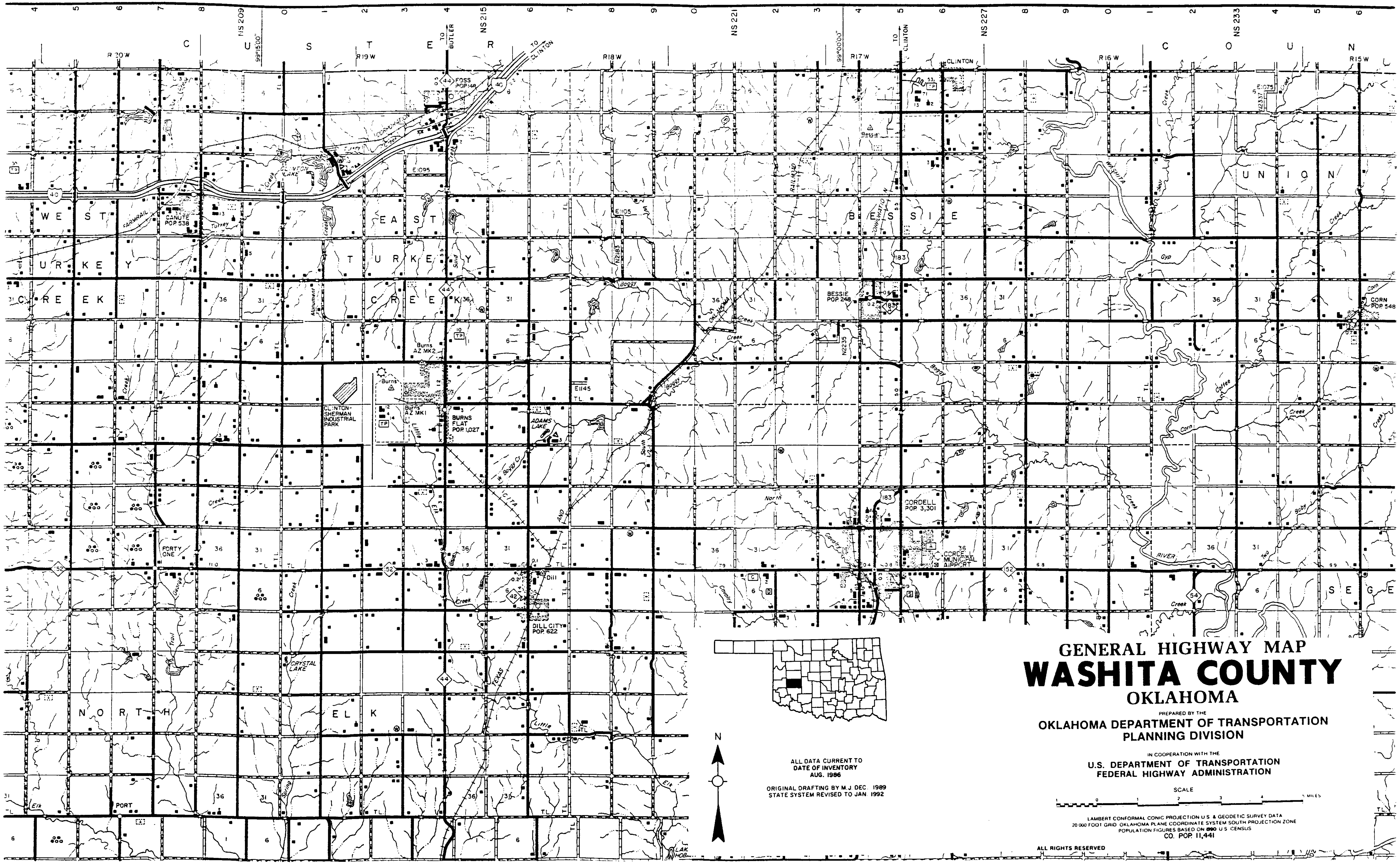
IN COOPERATION WITH THE
U.S. DEPARTMENT OF TRANSPORTATION
FEDERAL HIGHWAY ADMINISTRATION

SCALE
1 0 1 2 3 4 5 MILES

LAMBERT CONFORMAL CONIC PROJECTION U.S. COAST & GEODETIC SURVEY DATA
20 000 FOOT GRID OKLAHOMA PLANE COORDINATE SYSTEM NORTH PROJECTION ZONE
POPULATION FIGURES BASED ON 1990 U.S. CENSUS

CO. POP. 26,897

REFERENCE 12


GENERAL HIGHWAY MAP
WASHITA COUNTY
OKLAHOMA
PREPARED BY THE
OKLAHOMA DEPARTMENT OF TRANSPORTATION
PLANNING DIVISION
IN COOPERATION WITH THE
U.S. DEPARTMENT OF TRANSPORTATION
FEDERAL HIGHWAY ADMINISTRATION
SCALE
LAMBERT CONFORMAL CONIC PROJECTION U.S. & GEODETIC SURVEY DATA
20 000 FOOT GRID OKLAHOMA PLANE COORDINATE SYSTEM SOUTH PROJECTION ZONE
POPULATION FIGURES BASED ON 1990 U.S. CENSUS
CO. POP. 11,441
ALL RIGHTS RESERVED
ALL DATA CURRENT TO
DATE OF INVENTORY
AUG. 1986
ORIGINAL DRAFTING BY M.J. DEC. 1989
STATE SYSTEM REVISED TO JAN. 1992
N
C U S T E R C O U N
R 20 W
R 19 W
R 18 W
R 17 W
R 16 W
R 15 W
FOSS POP 148
CANUTE POP 538
CLINTON LAKE
BESSIE POP 248
CORN POP 548
BURNS FLAT POP 1,027
CLINTON-SHERMAN INDUSTRIAL PARK
ADAMS LAKE
CORDELL POP 3,301
CORDELL MUNICIPAL AIRPORT
DILL CITY POP 622
FORTY ONE
CRYSTAL LAKE
PORT
W E S T
E A S T
T U R K E Y
C R E E K
B E S S I E
U N I O N
N O R T H
E L K
S E G E
TO CLINTON
TO BUTLER

REFERENCE 13

COMMUNICATION REFERENCE

From:
Linda Ray
Custer County Rural Water District 3
580-593-2561

To:
Kent Curtis, Environmental Specialist II
Cherokee Nation's Office of Environmental Services (OES)
P. O. Box 948
Tahlequah, Oklahoma 74465
918-458-5498

Date and Time: Telephone conversation at 1125 hours on 18 June, 2003

Subject: Custer County Rural Water District 3

Linda told Kent the following:

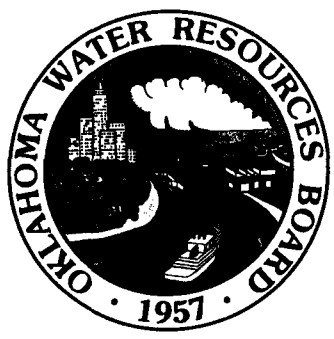
Custer County Rural Water District 3 obtains its water from three groundwater wells located five miles north of the city of Weatherford, Oklahoma. These wells are protected by a wellhead protection area, but Linda did not know the diameter or boundaries of the wellhead protection area. Custer County Rural Water District 3 provides drinking water to most of central Custer County and to a small portion of Washita County just southeast of the city of Clinton. The number of private wells within the service area is unknown. Residences outside the RWD3 service area to the west and southwest of Clinton obtain their drinking water from private wells or from the Frontier Development Authority Rural Water District.

REFERENCE 14

RURAL WATER SYSTEMS IN OKLAHOMA

Planning and Management Division
Oklahoma Water Resources Board

Publication Number 138



January 1998

Main Office:
3800 N. Classen Blvd.
Oklahoma City, Oklahoma 73118
Phone: (405) 530-8800
Fax: (405) 530-8900

Branch Offices:

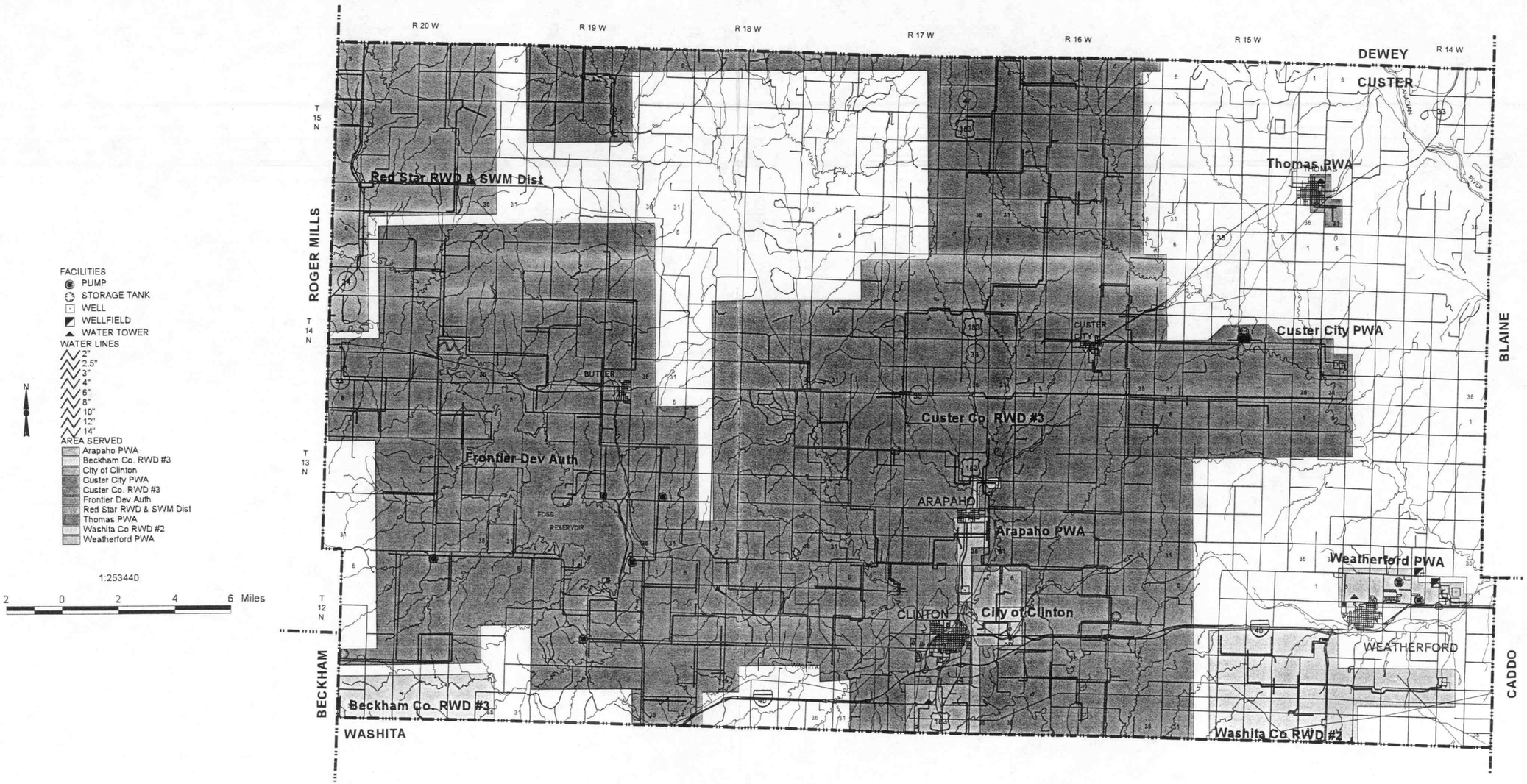
Lawton
Phone: (405)248-7762
Fax: (405)248-0737

McAlester
Phone: (918)426-5435
Fax: (918)426-6144

Tulsa
Phone: (918)581-2924
Fax: (918)581-2754

Woodward
Phone: (405)256-1014
Fax: (405)256-1015

RURAL WATER SYSTEM NAME	Custer Co. RWD #3	Arapaho PWA	Butler PWA	Custer City PWA	Frontier Dev Auth	Thomas PWA	Weatherford PWA	City of Clinton
Year Survey Completed	1995	1995	1995	1995	1995	1995	1995	1995
Year Map Completed	1995	1995	ALCL	1995	1995	1995	1995	1995
Manager Name	Mike Harris	Buford McDow	Vernon K. Raper	Ron Fergason	Vernon K. Raper	Bill Haney	Arnold Miller	Alvin Knauf
Manager Phone Number	(405) 593-2561	(405) 323-4376	(405) 664-3915	(405) 593-2312	(405) 664-3915	(405) 661-3687	(405) 772-7451	(405) 323-0217
Year System Began Operation	1978	1911	1976	1974	1979	1975	1903	1926
Population Served	960	801	300	900	1,200	1,246	15,000	12,500
Master Meters	3	0	1	1	1	0	0	0
Residential Meters	354	323	160	232	250	448	4,000	4,008
Commercial Meters	9	20	0	13	0	54	200	0
Industrial Meters	7	0	0	0	0	3	3	0
Other Meters	0	0	0	0	0	0	0	0
Percentage of System Metered	100%	100%	100%	100%	100%	98%	100%	80%
Average Daily Use (1000 GPD)	89	71	30	90	80	129	--	2,000
Maximum Daily Demand (1000 GPD)	115	101	50	150	120	225	--	3,000
Percapita Daily Use (GPD)	92	89	100	100	67	104	150	--
Minimum Residential Rate	$21.00 / 1000 gallons	$17.50 / 3000 gallons	$14.00 / 2000 gallons	$13.00 / 2000 gallons	$34.00 / 1000 gallons	$6.75 / 1000 gallons	$2.00 / 2000 gallons	$5.50 / 2000 gallons
Minimum Pasture Rate	--	--	--	--	--	--	--	--
Water Supply Type	Both	Purchased	Both	Supplied	Both	Supplied	Supplied	Both
Water Supply Description/Amount	GW, Custer City Well, S30 T14N R14W -- RWD #3, S5 T13N R14W -- Custer City PWA 320 A.F.	City of Clinton --	RS, Foss Reservoir -- City of Hobart --	GW, Rush Springs Aquifer, -- S30 T14N R14W --	RS, Foss Reservoir -- City of Hobart --	GW, City of Thomas, -- S31 T15N R14W --	GW, Rush Springs Sandstone --	SW, Clinton Lake -- GW, Wells, near Burnes Flat, OK -- Foss Master Cons. Dist. 555,000.00
Water Rights	Y	N	N	Y	N	Y	Y	Y
Allocated Acre Feet	400	--	--	320	--	160	3,282	3,980
Standby Source	Y	N	N	N	N	N	N	Y
Name of Standby Source	Custer City PWA	--	--	--	--	--	--	Water Wells
Amount of Standby (Gallons)	100,000	--	--	--	--	--	--	700
Customers >100,000 Gallons/Month	Y	N	N	Y	N	Y	Y	Y
Customer Name/Gallons Provided	Cherokee Restaurant 114,000			Custer Co. RWD #3 1,078,000		Hamm & Phillips 156,000 Thomas Hospital 365,000 Thomas School 124,000	Country West Homeowners Assn. --	Town of Arapaho 28,809,000
Treatment System Rating	Excellent	--	--	--	--	Good	Good	Good
Treatment System Inadequacies	--	--	--	--	--	--	--	Excessive Trihalomethanes
Water Treatment Capacity (GPD)	200,000	--	--	--	--	250,000	6,000,000	2,600,000
Treated Storage Capacity (Gallons)	80,000	200,000	120,000	68,000	12,000,000	350,000	3,000,000	9,000,000
Raw Water Storage Capacity (Gallons)	--	0	150,000	0	150,000	--	400,000	--
Distribution System Rating	Fair	Good	Good	Good	Good	Excellent	Excellent	Good
Distribution System Inadequacies	Original construction was poor	--	--	--	--	--	--	Replace 2" lines with 6" water mains
Percentage of Water Lost	20%	17%	8%	8%	7%	--%	5%	--%


FACILITIES
PUMP
STORAGE TANK
WELL
WELLFIELD
WATER TOWER
WATER LINES
2"
2.5"
3"
4"
6"
8"
10"
12"
14"
AREA SERVED
Arapaho PWA
Beckham Co. RWD #3
City of Clinton
Custer City PWA
Custer Co. RWD #3
Frontier Dev Auth
Red Star RWD & SWM Dist
Thomas PWA
Washita Co RWD #2
Weatherford PWA
1:253440
2 0 2 4 6 Miles
R 20 W
R 19 W
R 18 W
R 17 W
R 16 W
R 15 W
R 14 W
T 15 N
T 14 N
T 13 N
T 12 N
ROGER MILLS
BECKHAM
DEWEY
CUSTER
BLAINE
CADDO
WASHITA
Red Star RWD & SWM Dist
Thomas PWA
Custer City PWA
Custer Co. RWD #3
Frontier Dev Auth
Arapaho PWA
City of Clinton
Weatherford PWA
Beckham Co. RWD #3
Washita Co RWD #2
THOMAS
CUSTER CITY
BUTLER
ARAPAHO
CLINTON
WEATHERFORD
FOSS RESERVOIR

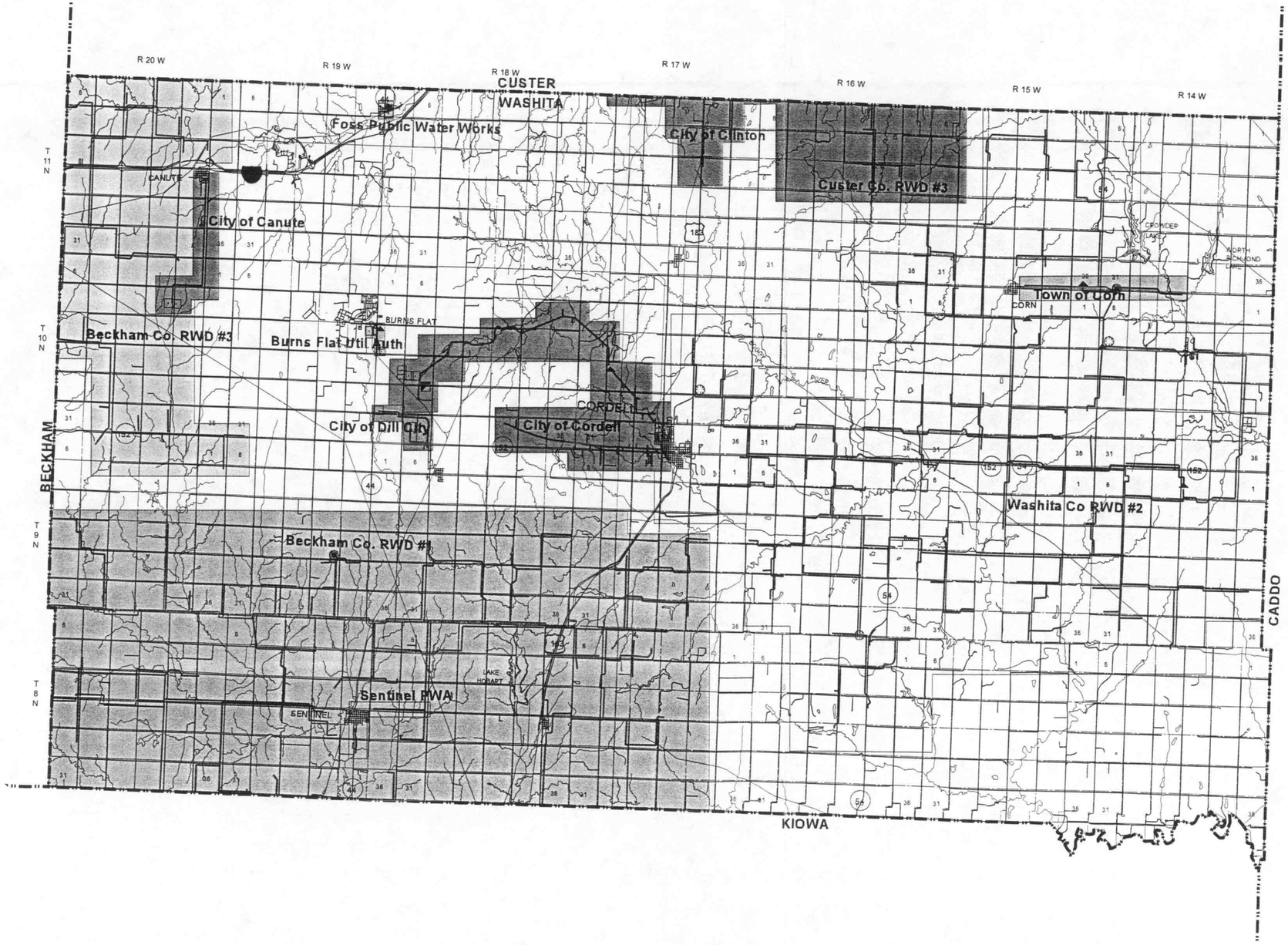
Rural Water Systems in Oklahoma

WASHITA COUNTY

Water System Information

RURAL WATER SYSTEM NAME	Washita Co. RWD #2	City of Bessie	Burns Flat Util. Auth.	City of Canute	City of Cordell	City of Dill City	Foss Public Water Works	City of Rocky	Sentinel PWA
Year Survey Completed	1995	1995	1995	1995	1995	1995	1995	1995	1995
Year Map Completed	1995	0	1995	1995	1995	1995	1995	1995	1995
Manager Name	Kevin Intemann	Carl Holliman	Joel Newberry	Jimmy Hassell	Jerry L. Berry	Michael Allen	Terry V. Price	Venoy Foust	Curtis Chandler Jr.
Manager Phone Number	(405) 337-6322	(405) 337-6677	(405) 562-3144	(405) 472-3111	(405) 832-3825	(405) 674-3376	(405) 592-4513	(405) 666-2211	(405) 393-2171
Year System Began Operation	1976	1959	1985	1956	1920	1926	1907	--	1988
Population Served	1,000	300	200	548	2,903	600	150	260	950
Master Meters	1	0	3	2	4	2	2	1	0
Residential Meters	335	105	90	250	500	205	54	105	433
Commercial Meters	0	0	0	31	40	9	2	7	13
Industrial Meters	0	0	15	0	25	0	0	0	0
Other Meters	202	0	0	0	0	0	6	0	0
Percentage of System Metered	100%	100%	100%	100%	96%	100%	100%	--%	100%
Average Daily Use (1000 GPD)	158	--	23	50	324	50	13	--	--
Maximum Daily Demand (1000 GPD)	183	--	35	95	600	80	13	--	--
Percapita Daily Use (GPD)	158	--	115	91	112	83	87	--	--
Minimum Residential Rate	$14.00 / 1000 gallons	$10.00 / 1000 gallons	$10.25 / 2000 gallons	$10.35 / 2000 gallons	$10.00 Minimum	$17.50 / 2000 gallons	$8.00 / 2000 gallons	--	$12.00 / 1000 gallons
Minimum Pasture Rate	--	--	--	--	--	--	--	--	--
Water Supply Type	Supplied	Purchased	Supplied	Both	Both	Purchased	Supplied	Purchased	Purchased
Water Supply Description/Amount	GW, Wells, S25 T1ON R14W -- GW, Wells, S23 T12N R14W	-- RS, Foss Reservoir -- Washita Co. Rural Water	-- GW, Wells, Bryan acres -- GW, Well Cimmaron & 44 hwy	-- GW -- L.M. Davis 2,000,000/Mo.	-- GW -- Foss Water System	-- GW -- Orval McMannaman	GW, Well #1, South -- GW, Well #2, North	-- Beckham Co. RWD #1	-- Beckham Co. RWD --
Water Rights	Y	N	Y	Y	Y	N	Y	N	N
Allocated Acre Feet	390	--	447.4	157	2,371	--	459	--	--
Standby Source	Y	Y	Y	Y	Y	N	Y	Y	N
Name of Standby Source	5 wells	Water tower	Well, 50B	City wells	Foss Lake	--	Frontier Dev. Auth.	Standpipe	--
Amount of Standby (Gallons)	90 gal./min., each well	103,000	250 gal./min.	201,600	--	--	--	100,000	--
Customers >100,000 Gallons/Month	Y	N	N	N	N	N	N	N	N
Customer Name/Gallons Provided	Ray Brown 2,909,000								
Treatment System Rating	Good	--	Good	Excellent	Good	Excellent	Excellent	--	--
Treatment System Inadequacies	--	Do not treat water	--	--	--	--	--	Do not treat water	--
Water Treatment Capacity (GPD)	130,000	--	35,000	201,600	324,000	50,000	13,000	--	--
Treated Storage Capacity (Gallons)	217,000	103,000	48,000	136,000	1,600,000	233,000	55,000	--	350,000
Raw Water Storage Capacity (Gallons)	217,000	--	48,000	0	1,600,000	0	0	--	0
Distribution System Rating	Excellent	Good	Excellent	Good	Good	Excellent	Good	Good	Good
Distribution System Inadequacies	--	--	--	--	--	--	--	--	--
Percentage of Water Lost	16%	--%	14%	8%	--%	5%	10%	--%	16%

RURAL WATER SYSTEM NAME	Town of Corn
Year Survey Completed	1995
Year Map Completed	1995
Manager Name	Willard Couch
Manager Phone Number	(405) 343-2255
Year System Began Operation	1954
Population Served	560
Master Meters	1
Residential Meters	201
Commercial Meters	18
Industrial Meters	0
Other Meters	12
Percentage of System Metered	100%
Average Daily Use (1000 GPD)	92
Maximum Daily Demand (1000 GPD)	193
Percapita Daily Use (GPD)	164
Minimum Residential Rate	$7.00 / 3000 gallons
Minimum Pasture Rate	--
Water Supply Type	Supplied
Water Supply Description/Amount	GW --
Water Rights	Y
Allocated Acre Feet	236
Standby Source	N
Name of Standby Source	--
Amount of Standby (Gallons)	--
Customers >100,000 Gallons/Month	Y
Customer Name/Gallons Provided	Corn Heritage Village 200,000
Treatment System Rating	Good
Treatment System Inadequacies	--
Water Treatment Capacity (GPD)	193,000
Treated Storage Capacity (Gallons)	230,000
Raw Water Storage Capacity (Gallons)	0
Distribution System Rating	Good
Distribution System Inadequacies	--
Percentage of Water Lost	8%


R 20 W
R 19 W
R 18 W
R 17 W
R 16 W
R 15 W
R 14 W
CUSTER
WASHITA
BECKHAM
CADDO
KIOWA
T 11 N
T 10 N
T 9 N
T 8 N
Foss Public Water Works
City of Clinton
Custer Co. RWD #3
CANUTE
City of Canute
Beckham Co. RWD #3
Burns Flat Util Auth
BURNS FLAT
City of Dill City
CORDELL
City of Cordell
Town of Corn
CORN
CROWDER LAKE
NORTH RICHMOND LAKE
Washita Co RWD #2
Beckham Co. RWD #1
Sentinel PWA
SENTINEL
LAKE HOBART
PUEBLO
FACILITIES
PUMP
STORAGE TANK
WELL
WELLFIELD
WATER TOWER
WATER LINES
2"
2.5"
3"
4"
5"
6"
8"
10"
AREA SERVED
Beckham Co. RWD #1
Beckham Co. RWD #3
Burns Flat Util Auth
City of Canute
City of Clinton
City of Cordell
City of Dill City
Custer Co. RWD #3
Foss Public Water Works
Sentinel PWA
Town of Corn
Washita Co RWD #2
N
1:253440
2 0 2 4 6 Miles

REFERENCE 15

U.S. DEPARTMENT OF COMMERCE

WEATHER BUREAU

PB88-237961

TECHNICAL PAPER NO. 40

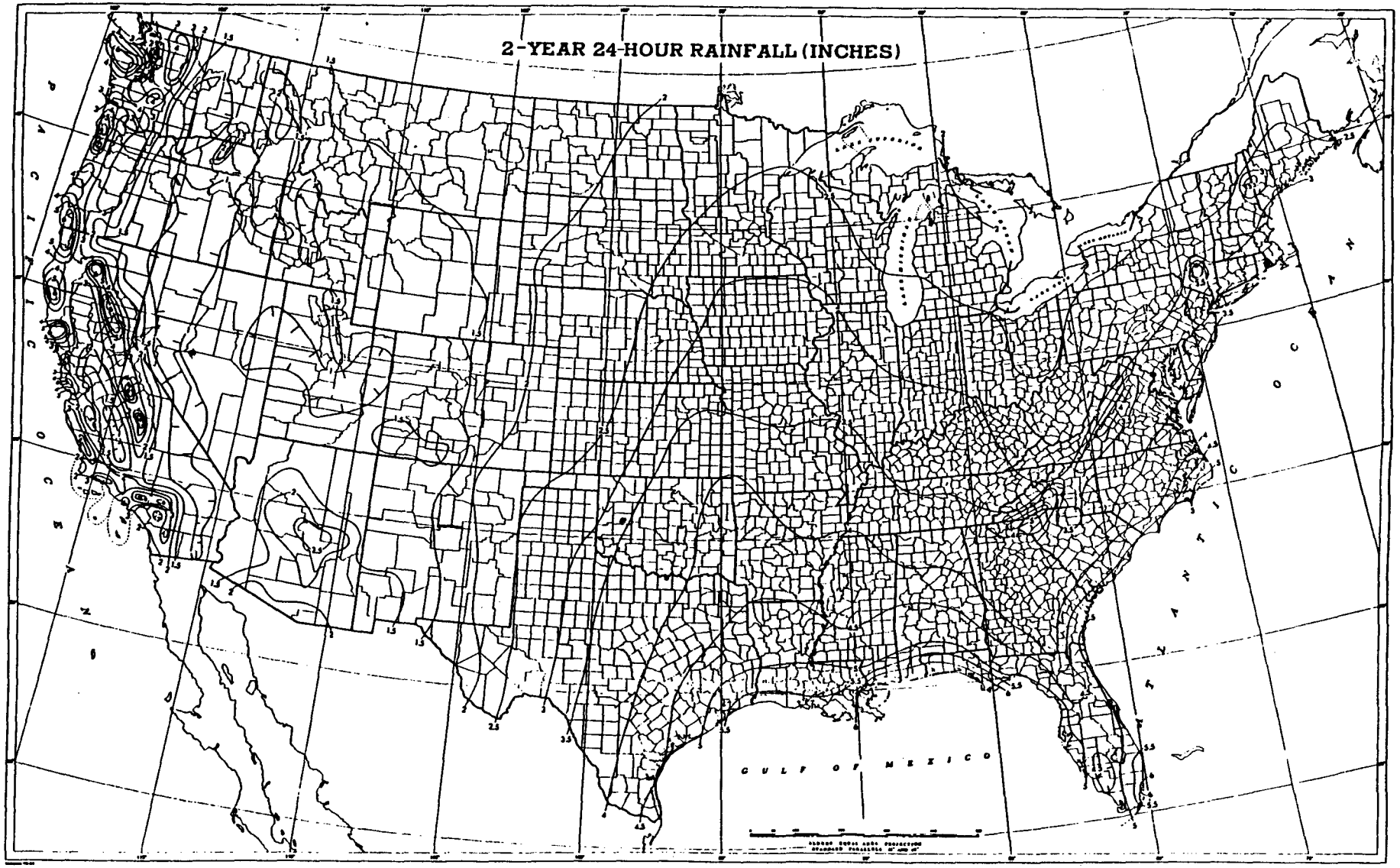
RAINFALL FREQUENCY ATLAS OF THE UNITED STATES

for Durations from 30 Minutes to 24 Hours and Return Periods from 1 to 100 Years

WASHINGTON, D.C.

May 1961

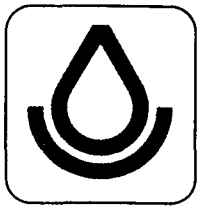
Republished and Reprinted January 1963


2-YEAR 24-HOUR RAINFALL (INCHES)
GULF OF MEXICO

REFERENCE 16

SOIL SURVEY OF

Custer County, Oklahoma



United States Department of Agriculture
Soil Conservation Service

In cooperation with
Oklahoma Agricultural Experiment Station

Contents

Issued April, 1978

SOIL SURVEY OF CUSTER COUNTY, OKLAHOMA

BY ODOS G. HENSON, SOIL CONSERVATION SERVICE

UNITED STATES DEPARTMENT OF AGRICULTURE, SOIL CONSERVATION SERVICE,
IN COOPERATION WITH OKLAHOMA AGRICULTURAL EXPERIMENT STATION

CUSTER COUNTY is in the west-central part of Oklahoma (fig. 1). Arapaho is the county seat. The county has an area of 640,640 acres, or 1,001 square miles. It lies within Central Rolling Red Plains physiographic region.

Farming is the principal source of income. About 50 percent of the county is rangeland. The rest is cropland used mainly for growing small grain, cotton, grain sorghum, and alfalfa.

How This Survey Was Made

Soil scientists made this survey to learn what kinds of soil are in Custer County, where they are located, and how they can be used. The soil scientists went into the county knowing they likely would find many soils they had already seen and perhaps some they had not. They observed the steepness, length, and shape of slopes, the size and speed of streams, the kinds of native plants or crops, the kinds of rock, and many facts about the soils. They dug many holes to expose soil profiles. A profile is the sequence of natural layers, or horizons, in a soil; it extends from the surface down into the parent material that has not been changed much by leaching or by the action of plant roots.

The soil scientists made comparisons among the profiles they studied, and they compared these profiles with those in counties nearby and in places more distant. They classified and named the soils according to nationwide, uniform procedures. The *soil series* and the *soil phase* are the categories of soil classification most used in a local survey.

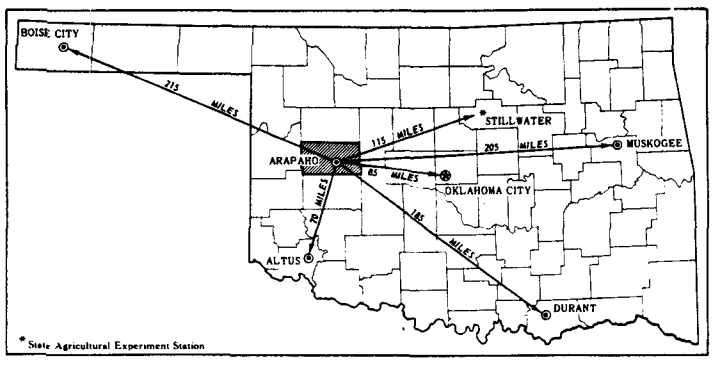


Figure 1.—Location of Custer County in Oklahoma.

Soils that have profiles almost alike make up a soil series. Except for different texture in the surface layer, all the soils of one series have major horizons that are similar in thickness, arrangement, and other important characteristics. Each soil series is named for a town or other geographic feature near the place where a soil of that series was first observed and mapped. Cordell and Cornick, for example, are the names of two soil series. All the soils in the United States having the same series name are essentially alike in those characteristics that affect their behavior in the undisturbed landscape.

Soils of one series can differ in texture of the surface layer and in slope, stoniness, or some other characteristic that affects use of the soils by man. On the basis of such differences, a soil series is divided into phases. The name of a soil phase indicates a feature that affects management. For example, Carey silt loam, 1 to 3 percent slopes, is one of several phases within the Carey series.

After a guide for classifying and naming the soils had been worked out, the soil scientists drew the boundaries of the individual soils on aerial photographs. These photographs show woodlands, buildings, field borders, trees, and other details that help in drawing boundaries accurately. The soil map at the back of this publication was prepared from aerial photographs.

The areas shown on a soil map are called mapping units. On most maps detailed enough to be useful in planning the management of farms and fields, a mapping unit is nearly equivalent to a soil phase. It is not exactly equivalent, because it is not practical to show on such a map all the small, scattered bits of soil of some kind that have been seen within an area that is dominantly of a recognized soil phase.

Some mapping units are made up of soils of different series, or of different phases within one series. Two such kinds of mapping units are shown on the soil map of Custer County: soil complexes and undifferentiated groups.

A soil complex consists of areas of two or more soils, so intricately intermingled or so small in size that they cannot be shown separately on the soil map. Each area of a complex contains some of each of the two or more dominant soils, and the pattern and relative propor-

Representative profile of Tivoli loamy fine sand in an area of Pratt and Tivoli soils, 8 to 12 percent slopes (W), 1,575 feet south and 75 feet west of the northeast corner of sec. 10, T. 15 N., R. 14 W.:

A1—0 to 6 inches, brown (10YR 5/3) loamy fine sand, brown (10YR 4/3) when moist; single grained; very friable; neutral; gradual, wavy boundary.
C—6 to 72 inches, light-brown (7.5YR 6/4) fine sand, brown (7.5YR 5/4) when moist; single grained; loose; neutral.

The A1 horizon is brown, grayish-brown, light brownish-gray, or pale-brown loamy fine sand or fine sand. It is neutral to mildly alkaline. The C horizon is light brown, brown, strong brown, reddish yellow, reddish brown, or light reddish brown. It is neutral to mildly alkaline.

Tivoli soils in this survey area are mapped only in an undifferentiated group with Pratt soils.

Woodward Series

The Woodward series consists of moderately deep, well-drained, very gently sloping to strongly sloping soils on uplands. These soils formed in material weathered from sandstone under a cover of native grasses.

In a representative profile the surface layer is 10 inches of reddish-brown silt loam. The subsoil, to a depth of 30 inches, is red silt loam. The underlying material is red partly weathered sandstone.

Permeability is moderate. Available water capacity is high.

Representative profile of Woodward silt loam in an area of Woodward-Quinlan complex, 5 to 12 percent slopes, 1,080 feet south and 30 feet east of the northwest corner of sec. 4, T. 14 N., R. 20 W.:

A1—0 to 10 inches, reddish-brown (5YR 4/4) silt loam, dark reddish brown (5YR 3/4) when moist; moderate, medium, granular structure; friable; calcareous; moderately alkaline; gradual, smooth boundary.
B2—10 to 30 inches, red (2.5YR 4/6) silt loam, dark red (2.5YR 3/6) when moist; weak, medium, granular structure; friable; calcareous; moderately alkaline; gradual, wavy boundary.
C—30 to 40 inches, red (2.5YR 4/6) partly weathered sandstone, dark red (2.5YR 3/6) when moist; calcareous; moderately alkaline.

The A1 or Ap horizon is reddish-brown, brown, or red silt loam or loam. It is moderately alkaline to neutral. The B2 horizon is reddish-brown or red silt loam or loam. It is mildly alkaline or moderately alkaline. Depth to sandstone is 20 to 40 inches.

WoB—Woodward silt loam, 1 to 3 percent slopes. This soil is very gently sloping.

Included with this soil in mapping are areas of a soil that is similar to this Woodward soil, but it is 40 to 60 inches deep over sandstone. This soil makes up about 40 percent of the mapped areas. Also included are areas of Carey and Quinlan soils. Carey soils make up about 5 percent of the unit, and Quinlan soils 3 percent.

Most of this soil is used for wheat. Some areas are in other small grain, grain sorghum, cotton, tame pasture grasses, and native grasses.

The main concerns of management are controlling erosion and maintaining soil structure and fertility. If this soil is well managed, most of the suited crops can be grown. Returning crop residue to the soil and supplying plant nutrients are good management practices. Terraces with protected outlets, contour farming, and minimum tillage are needed if row crops are grown. Capability unit IIe-1; Loamy Prairie range site; pasture and hayland suitability group 8A; tree suitability group 6.

WoC—Woodward silt loam, 3 to 5 percent slopes. This soil is gently sloping.

Included with this soil in mapping are areas of Quinlan, Minco, and Carey soils. Quinlan soils make up about 8 percent of the mapped areas, Minco soils 5 percent, and Carey soils 2 percent.

Most of this soil is used for wheat. Some areas are in other small grain, grain sorghum, cotton, tame pasture grasses, and native grasses.

The main concerns of management are controlling erosion and maintaining soil fertility and structure. If row crops are grown, terraces with protected outlets (fig. 7) and contour farming are needed. Where terraces are not used, a cropping system is needed that includes only soil-maintaining crops. Returning large amounts of crop residue to the soil and supplying plant nutrients help to maintain content of organic matter and fertility, to retain structure, and to increase the intake rate of water. Capability unit IIIe-1; Loamy Prairie range site; pasture and hayland suitability group 8A; tree suitability group 6.

WoD—Woodward silt loam, 5 to 8 percent slopes. This soil is sloping.

Included with this soil in mapping are areas of Quinlan and Minco soils. Quinlan soils make up about 10 percent of the mapped areas, and Minco soils 8 percent.

Most of this soil is used for wheat. Some areas are in other small grain, grain sorghum, tame pasture grasses, and native grasses.

The main concerns of management are controlling erosion and maintaining soil structure and fertility. Returning crop residue to the soil and supplying plant nutrients are good management practices. Terraces with protected outlets, contour farming, and minimum tillage are needed. Capability unit IVe-1; Loamy Prairie range site; pasture and hayland suitability group 8A; tree suitability group 6.

Wt—Woodward-Clairemont complex. These soils are nearly level to strongly sloping. About 45 percent of the complex is Woodward soils that have slopes of 1 to 12 percent, and 25 percent is Clairemont soils that have slopes of 0 to 1 percent. The Woodward soils have a profile similar to the one described as representative for the Woodward series, but the surface layer is silt loam or loam. The Clairemont soils have a profile similar to the one described as representative for the Clairemont series. Woodward and Clairemont soils are in such an intricate pattern that it is impractical to map them separately. Clairemont soils are frequently flooded.

Included with these soils in mapping are areas of Quinlan, Carey, St. Paul, and Yahola soils. Quinlan soils make up about 10 percent of the mapped areas, and Carey, St. Paul, and Yahola soils each about 5 percent. Also included are areas of a soil that is similar

Figure 7.—**Bermudagrass in an outlet in an area of Woodward silt loam, 3 to 5 percent slopes.**

to the Clairemont soil, but it is grayer in the uppermost 10 inches. This soil makes up about 5 percent of the mapped areas. Spots of Rock outcrop are also included.

Most of this complex is used as range. Some areas are used for tame pasture.

The main concern of management is keeping the grasses growing vigorously. Capability unit VIe-5; Woodward soils in Loamy Prairie range site, Clairemont soils in Loamy Bottomland range site; Woodward soils in pasture and hayland suitability group 8A, Clairemont soils in 2A; tree suitability group 6.

WwC—Woodward-Quinlan complex, 3 to 5 percent slopes. These gently sloping soils are in such an intricate pattern that it is impractical to map them separately. About 50 percent of the complex is Woodward soils, and about 40 percent is Quinlan soils. Both soils have profiles similar to the ones described as representative of their respective series, but their surface layer is silt loam or loam.

Included with these soils in mapping are areas of a soil that is similar to the Woodward soils but is not calcareous at a depth of 25 to 34 inches. This soil makes up about 3 percent of the complex. Also included are areas of a soil that is similar to the Quinlan soils but is less than 10 inches deep over sandstone or is neutral at a depth of 10 to 20 inches. This soil makes up about 7 percent of the mapped areas.

Most of this complex is used for wheat. Some areas are in other small grain, grain sorghum, tame pasture grasses, and native grasses.

The main concerns of management are controlling erosion and maintaining soil structure and fertility. Returning crop residue to the soil and supplying plant nutrients are good management practices. Terraces with protected outlets, contour farming, and minimum tillage are needed. Capability unit IVe-1; Woodward part in Loamy Prairie range site, Quinlan part in Shallow Prairie range site; Woodward part in pasture and hayland suitability group 8A, Quinlan part not assigned to a pasture and hayland suitability group; tree suitability group 7.

WwE—Woodward-Quinlan complex, 5 to 12 percent slopes. These sloping to strongly sloping soils are in such an intricate pattern that it is impractical to map them separately. About 50 percent of the complex is Woodward soils, and about 43 percent is Quinlan soils. Both soils have profiles similar to the ones described as representative of their respective series, but their surface layer is loam in places.

Included with Woodward and Quinlan soils in mapping is about 7 percent soils that are similar to Woodward soils but are 40 to 60 inches thick over sandstone. Also included are spots of Rock outcrop and of soils that are similar to Quinlan soils but are less than 10 inches thick over sandstone.

Most of this complex is used as range. The Woodward soils are also used for tame pasture.

The main concern of management is keeping the grasses growing vigorously. Capability unit VIe-6; Woodward part in Loamy Prairie range site, Quinlan part in Shallow Prairie range site; Woodward part in pasture and hayland suitability group 8A, Quinlan part not assigned to a pasture and hayland suitability group; tree suitability group 7.

1 ¾ ½ ¼ 0 1 Mile

5 000 4 000 3 000 2 000 1 000 0 5 000 Feet

Scale 1:20000

N

175 000 FEET

(Joins sheet 71)

R. 18 W. | R. 17 W. | (Joins sheet 62)

1 690 000 FEET

WASHITA COUNTY

1 705 000 FEET

185 000 FEET

(Joins sheet 73)

T. 12 N.

site

CUSTER COUNTY, OKLAHOMA — SHEET NUMBER 72

This map is compiled on 1974 aerial photography by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies.
Coordinate grid ticks and land division corners, if shown, are approximately positioned.

CUSTER COUNTY, OKLAHOMA NO. 72

REFERENCE 17

REFERENCE 18

COMMUNICATION REFERENCE

From:
Alvin Knauf, Public Works Director
City of Clinton, Oklahoma
580-323-4330, or 580-592-4554, or mobile phone number (b) (6) [redacted]

To:
Kent Curtis, Environmental Specialist II
Cherokee Nation's Office of Environmental Services (OES)
P. O. Box 948
Tahlequah, Oklahoma 74465
918-458-5498

Date and Time: Telephone conversation at 0900 hours on 18 June, 2003

Subject: Drinking water system for Clinton, Oklahoma

Alvin told Kent the following:

Clinton Lake is the primary source of drinking water for the city of Clinton. Clinton Lake is located just north of Interstate Highway 40, halfway between Foss and Canute, approximately 15 to 20 miles west of Clinton. Foss Lake is the backup source of drinking water for the city of Clinton. Foss Lake is located six miles north of Clinton Lake. Clinton does not obtain any drinking water from a groundwater well.

The town of Arapaho buys all its drinking water from Clinton.

REFERENCE 19

United States
Environmental Protection
Agency

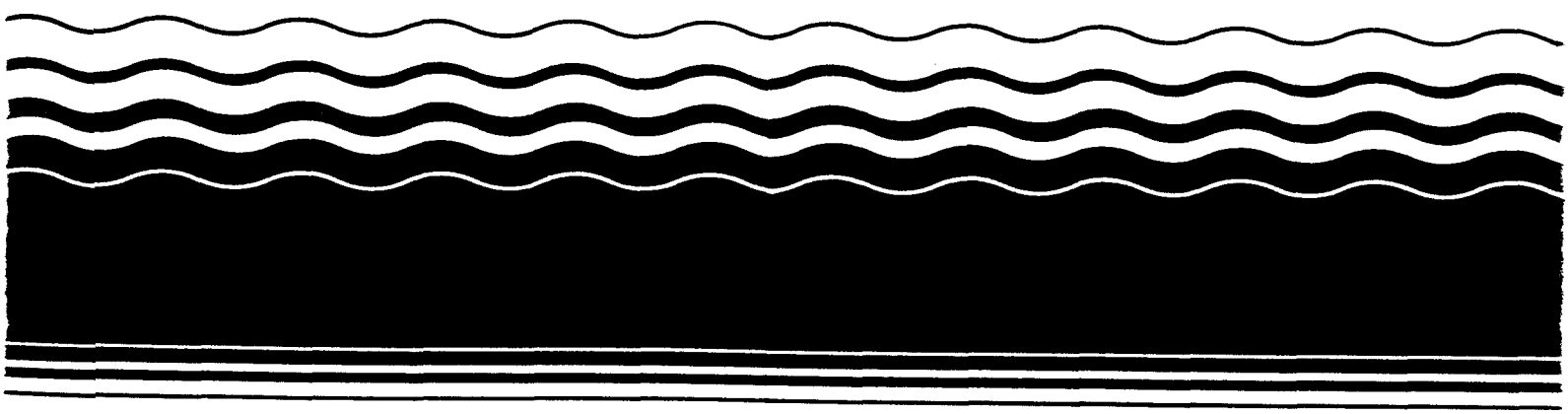
Office of Solid Waste
and Emergency
Response

Publication 9345.1-07
PB92-963377
EPA 540-R-92-026
November 1992

Superfund

EPA

Hazard Ranking System Guidance Manual



EPA540-R-92-026
OSWER Directive 9345.1-07
November 1992

The Hazard Ranking System Guidance Manual

Interim Final

Hazardous Site Evaluation Division
Office of Solid Waste and Emergency Response
U.S. Environmental Protection Agency
Washington, DC 20460

REFERENCE 20

BESSIE, OKLA.

1 MILE

es

SPECIAL NOTE

This document was prepared primarily by stereoscopic analysis of high altitude aerial photographs. Wetlands were identified on the photographs based on vegetation, visible hydrology, and geography in accordance with **Classification of Wetlands and Deepwater Habitats of the United States** (FWS/OBS - 79/31 December 1979). The aerial photographs typically reflect conditions during the specific year and season when they were taken. In addition, there is a margin of error inherent in the use of the aerial photographs. Thus, a detailed on the ground and historical analysis of a single site may result in a revision of the wetland boundaries established through photographic interpretation. In addition, some small wetlands and those obscured by dense forest cover may not be included on this document.

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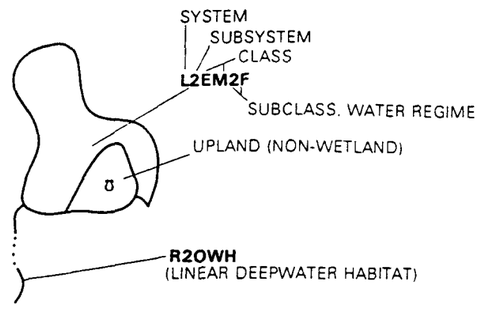
SYMBOLOGY EXAMPLE



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- This map uses the class Unconsolidated Shore (US). On earlier NWI maps that class was designated Beach/Bar (BB), or Flat (FL). Subclasses remain the same in both versions.

AERIAL PHOTOGRAPHY

DATE:	10/ /81	DATE: ___/___/___
SCALE:	1:58 000	SCALE:
TYPE:	CIR	TYPE:

U.S. DEPARTMENT OF THE INTERIOR

FISH AND WILDLIFE SERVICE

Prepared by National Wetlands Inventory

1989

E — ESTUARINE (SYSTEM)

2 — INTERTIDAL (SUBSYSTEM)

C BED	RF — REEF	RS — ROCKY SHORE	US — UNCONSOLIDATED SHORE
ular ubmergent	1 Coral 3 Worm	1 Bedrock 2 Rubble	1 Cobble-Gravel 2 Sand 3 Mud 4 Organic

1 — SUBTIDAL (SUBSYSTEM)

RB — ROCK BOTTOM	UB — UNCONSOLIDATED BOTTOM	AB — AQUATIC BED	RF — REEF	OW — *OPEN WATER/ Unknown Bottom*
1 Bedrock 2 Rubble	1 Cobble-Gravel 2 Sand 3 Mud 4 Organic	1 Algal 3 Rooted Vascular 4 Floating Vascular 5 *Unknown Submergent* 6 *Unknown Surface*	2 Mollusc 3 Worm	

2 — INTERTIDAL (SUBSYSTEM)

AB — AQUATIC BED	RF — REEF	SB — STREAMBED	RS — ROCKY SHORE	US — UNCONSOLIDATED SHORE	EM — EMERGENT	SS — SCRUB-SHRUB	FO — FORESTED
1 Algal 3 Rooted Vascular 4 Floating Vascular 5 *Unknown Submergent* 6 *Unknown Surface*	2 Mollusc 3 Worm	1 Cobble-Gravel 2 Sand 3 Mud 4 Organic	1 Bedrock 2 Rubble	1 Cobble-Gravel 2 Sand 3 Mud 4 Organic	1 Persistent 2 Nonpersistent	1 Broad-Leaved Deciduous 2 Needle-Leaved Deciduous 3 Broad-Leaved Evergreen 4 Needle-Leaved Evergreen 5 Dead 6 *Deciduous* 7 *Evergreen*	1 Broad-Leaved Deciduous 2 Needle-Leaved Deciduous 3 Broad-Leaved Evergreen 4 Needle-Leaved Evergreen 5 Dead 6 *Deciduous* 7 *Evergreen*

L — LACUSTRINE (SYSTEM)

1 — LIMNETIC (SUBSYSTEM)

RB — ROCK BOTTOM	UB — UNCONSOLIDATED BOTTOM	AB — AQUATIC BED	OW — *OPEN WATER/ Unknown Bottom*
1 Bedrock 2 Rubble	1 Cobble-Gravel 2 Sand 3 Mud 4 Organic	1 Algal 2 Aquatic Moss 3 Rooted Vascular 4 Floating Vascular 5 *Unknown Submergent* 6 *Unknown Surface*	

2 — LITTORAL (SUBSYSTEM)

RB — ROCK BOTTOM	UB — UNCONSOLIDATED BOTTOM	AB — AQUATIC BED	RS — ROCKY SHORE	US — UNCONSOLIDATED SHORE	EM — EMERGENT	OW — *OPEN WATER/ Unknown Bottom*
1 Bedrock 2 Rubble	1 Cobble-Gravel 2 Sand 3 Mud 4 Organic	1 Algal 2 Aquatic Moss 3 Rooted Vascular 4 Floating Vascular 5 *Unknown Submergent* 6 *Unknown Surface*	1 Bedrock 2 Rubble	1 Cobble-Gravel 2 Sand 3 Mud 4 Organic 5 Vegetated	2 Nonpersistent	

ENNIAL **4 — INTERMITTENT** **5 — UNKNOWN PERENNIAL** (SUBSYSTEM)

SHORE	US — UNCONSOLIDATED SHORE	**EM — EMERGENT	OW — *OPEN WATER/ Unknown Bottom*
	1 Cobble-Gravel 2 Sand 3 Mud 4 Organic 5 Vegetated	2 Nonpersistent	

UBSYSTEM.
EMS.

S-LICHEN	EM — EMERGENT	SS — SCRUB-SHRUB	FO — FORESTED	OW — *OPEN WATER/ Unknown Bottom*
	1 Persistent 2 Nonpersistent	1 Broad-Leaved Deciduous 2 Needle-Leaved Deciduous 3 Broad-Leaved Evergreen 4 Needle-Leaved Evergreen 5 Dead 6 *Deciduous* 7 *Evergreen*	1 Broad-Leaved Deciduous 2 Needle-Leaved Deciduous 3 Broad-Leaved Evergreen 4 Needle-Leaved Evergreen 5 Dead 6 *Deciduous* 7 *Evergreen*	

MODIFIERS

In order to more adequately describe wetland and deepwater habitats one or more of the water regime, water chemistry, soil, or special modifiers may be applied at the class or lower level in the hierarchy. The farmed modifier may also be applied to the ecological system.

WATER REGIME

Non-Tidal

- A Temporarily Flooded
- B Saturated
- C Seasonally Flooded
- D *Seasonally Flooded/ Well Drained*
- E *Seasonally Flooded/ Saturated*
- F Semipermanently Flooded
- G Intermittently Exposed
- H Permanently Flooded
- J Intermittently Flooded
- K Artificially Flooded
- W Intermittently Flooded/Temporary
- Y Saturated/Semipermanent/ Seasonal
- Z Intermittently Exposed/Permanent
- U *Unknown*

Tidal

- K *Artificially Flooded*
- L Subtidal
- M Irregularly Exposed
- N Regularly Flooded
- P Irregularly Flooded
- *S Temporary-Tidal
- *R Seasonal-Tidal
- *T Semipermanent-Tidal
- *V Permanent-Tidal
- U *Unknown*

*These water regimes are only used in tidally influenced, freshwater systems.

WATER CHEMISTRY

Coastal Halinity

- 1 Hyperhaline
- 2 Euhaline
- 3 Mixohaline *(Brackish)*
- 4 Polyhaline
- 5 Mesohaline
- 6 Oligohaline
- 0 Fresh

Inland Salinity

- 7 Hypersaline
- 8 Eusaline
- 9 Mixosaline
- 0 Fresh

pH Modifiers for all Fresh Water

- a Acid
- t Circumneutral
- i Alkaline

SOIL

- g Organic
- n Mineral

SPECIAL MODIFIERS

- b *Beaver*
- d *Partially Drained/Ditched*
- f Farmed
- h *Diked/Impounded*
- r Artificial Substrate
- s *Spoil*
- x Excavated

CLINTON SE
FORT COBB RESERVOIR

6254 IV SW

SCALE 1:24 000

1 0 1 MILE

1000 0 1000 2000 3000 4000 5000 6000 7000 FEET

1 5 0 1 KILOMETER

☐ 1 acre ☐ 10 acres ☐ 20 acres

ACREAGE GUIDE

Other information including a narrative report concerning the wetland resources depicted on this document may be available. For information, contact:

Regional Director (ARDE) Region II
U.S. Fish and Wildlife Service
P.O. Box 1306
Albuquerque, New Mexico 87103

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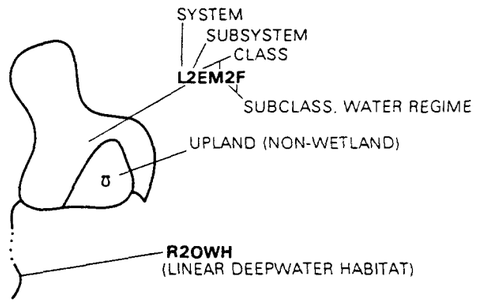

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AERIAL PHOTOGRAPHY

DATE:	10/ /81	DATE: / /
SCALE:	1:58 000	SCALE:
TYPE:	CIR	TYPE:

SYSTEM: M — MARINE

SUBSYSTEM	1 — SUBTIDAL					2 — INTERTIDAL			
CLASS	RB — ROCK BOTTOM	UB — UNCONSOLIDATED BOTTOM	AB — AQUATIC BED	RF — REEF	OW — *OPEN WATER/ Unknown Bottom*	AB — AQUATIC BED	RF — REEF	RS — ROCKY SHORE	US — UNCONSOLIDATED SHORE
Subclass	1 Bedrock 2 Rubble	1 Cobble-Gravel 2 Sand 3 Mud 4 Organic	1 Algal 3 Rooted Vascular 5 *Unknown Submergent*	1 Coral 3 Worm		1 Algal 3 Rooted Vascular 5 *Unknown Submergent*	1 Coral 3 Worm	1 Bedrock 2 Rubble	1 Cobble-Gravel 2 Sand 3 Mud 4 Organic

SYSTEM: E — ESTUARINE

SUBSYSTEM	1 — SUBTIDAL					2 — INTERTID
CLASS	RB — ROCK BOTTOM	UB — UNCONSOLIDATED BOTTOM	AB — AQUATIC BED	RF — REEF	OW — *OPEN WATER/ Unknown Bottom*	AB — AQUATIC BED	RF — REEF	SB — STREAMBED	RS — ROCKY SHORE	US
Subclass	1 Bedrock 2 Rubble	1 Cobble-Gravel 2 Sand 3 Mud 4 Organic	1 Algal 3 Rooted Vascular 4 Floating Vascular 5 *Unknown Submergent* 6 *Unknown Surface*	2 Mollusc 3 Worm		1 Algal 3 Rooted Vascular 4 Floating Vascular 5 *Unknown Submergent* 6 *Unknown Surface*	2 Mollusc 3 Worm	1 Cobble-Gravel 2 Sand 3 Mud 4 Organic	1 Bedrock 2 Rubble	1 C 2 S 3 M 4 C

SYSTEM: R — RIVERINE

SUBSYSTEM	1 — TIDAL	2 — LOWER PERENNIAL	3 — UPPER PERENNIAL	4 — INTERMITTENT	5 — UNKNOWN PERENNIAL
CLASS	RB — ROCK	UB — UNCONSOLIDATED BOTTOM	*SB — STREAMBED	AB — AQUATIC BED	RS — ROCKY SHORE	US — UNCONSOLIDATED SHORE	**EM — EMERGENT	OW — *OPEN WATER/ Unknown Bottom*
Subclass	1 Bedrock 2 Rubble	1 Cobble-Gravel 2 Sand 3 Mud 4 Organic	1 Bedrock 2 Rubble 3 Cobble-Gravel 4 Sand 5 Mud 6 Organic 7 Vegetated	1 Algal 2 Aquatic Moss 3 Rooted Vascular 4 Floating Vascular 5 *Unknown Submergent* 6 *Unknown Surface*	1 Bedrock 2 Rubble	1 Cobble-Gravel 2 Sand 3 Mud 4 Organic 5 Vegetated	2 Nonpersistent	

*STREAMBED is limited to TIDAL and INTERMITTENT SUBSYSTEMS, and comprises the only CLASS in the INTERMITTENT SUBSYSTEM.

**EMERGENT is limited to TIDAL and LOWER PERENNIAL SUBSYSTEMS. The remaining CLASSES are found in all SUBSYSTEMS.

SYSTEM: L — LACUSTRINE

SUBSYSTEM	1 — LIMNETIC				2 — LITTORA
CLASS	RB — ROCK BOTTOM	UB — UNCONSOLIDATED BOTTOM	AB — AQUATIC BED	OW — *OPEN WATER/ Unknown Bottom*	RB — ROCK BOTTOM	UB — UNCONSOLIDATED BOTTOM	AB — AQUATIC BED	RS — ROC SHO
Subclass	1 Bedrock 2 Rubble	1 Cobble-Gravel 2 Sand 3 Mud 4 Organic	1 Algal 2 Aquatic Moss 3 Rooted Vascular 4 Floating Vascular 5 *Unknown Submergent* 6 *Unknown Surface*		1 Bedrock 2 Rubble	1 Cobble-Gravel 2 Sand 3 Mud 4 Organic	1 Algal 2 Aquatic Moss 3 Rooted Vascular 4 Floating Vascular 5 *Unknown Submergent* 6 *Unknown Surface*	1 Bedrock 2 Rubble

SYSTEM: P — PALUSTRINE

CLASS	RB — ROCK BOTTOM	UB — UNCONSOLIDATED BOTTOM	AB — AQUATIC BED	US — UNCONSOLIDATED SHORE	ML — MOSS-LICHEN	EM — EMERGENT	SS — SCRUB-SHRUB	FO — FORESTED	OW — *OPEN WATER/ Unknown Bottom*
Subclass	1 Bedrock 2 Rubble	1 Cobble-Gravel 2 Sand 3 Mud 4 Organic	1 Algal 2 Aquatic Moss 3 Rooted Vascular 4 Floating Vascular 5 *Unknown Submergent* 6 *Unknown Surface*	1 Cobble-Gravel 2 Sand 3 Mud 4 Organic 5 Vegetated	1 Moss 2 Lichen	1 Persistent 2 Nonpersistent	1 Broad-Leaved Deciduous 2 Needle-Leaved Deciduous 3 Broad-Leaved Evergreen 4 Needle-Leaved Evergreen 5 Dead 6 *Deciduous* 7 *Evergreen*	1 Broad-Leaved Deciduous 2 Needle-Leaved Deciduous 3 Broad-Leaved Evergreen 4 Needle-Leaved Evergreen 5 Dead 6 *Deciduous* 7 *Evergreen*	

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- G Intermittently Exposed
- H Permanently Flooded
- J Intermittently Flooded
- K Artificially Flooded
- W Intermittently Flooded/Temporary
- Y Saturated/Semipermanent/ Seasonal
- Z Intermittently Exposed/Permanent
- U *Unknown*

Tidal

- K *Artificially Flooded*
- L Subtidal
- M Irregularly Exposed
- N Regularly Flooded
- P Irregularly Flooded
- * S Temporary-Tidal
- * R Seasonal-Tidal
- * T Semipermanent-Tidal
- * V Permanent-Tidal
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- 4 Polyhaline
- 5 Mesohaline
- 6 Oligohaline
- 0 Fresh

Inland Salinity

- 7 Hypersaline
- 8 Eusaline
- 9 Mixosaline
- 0 Fresh

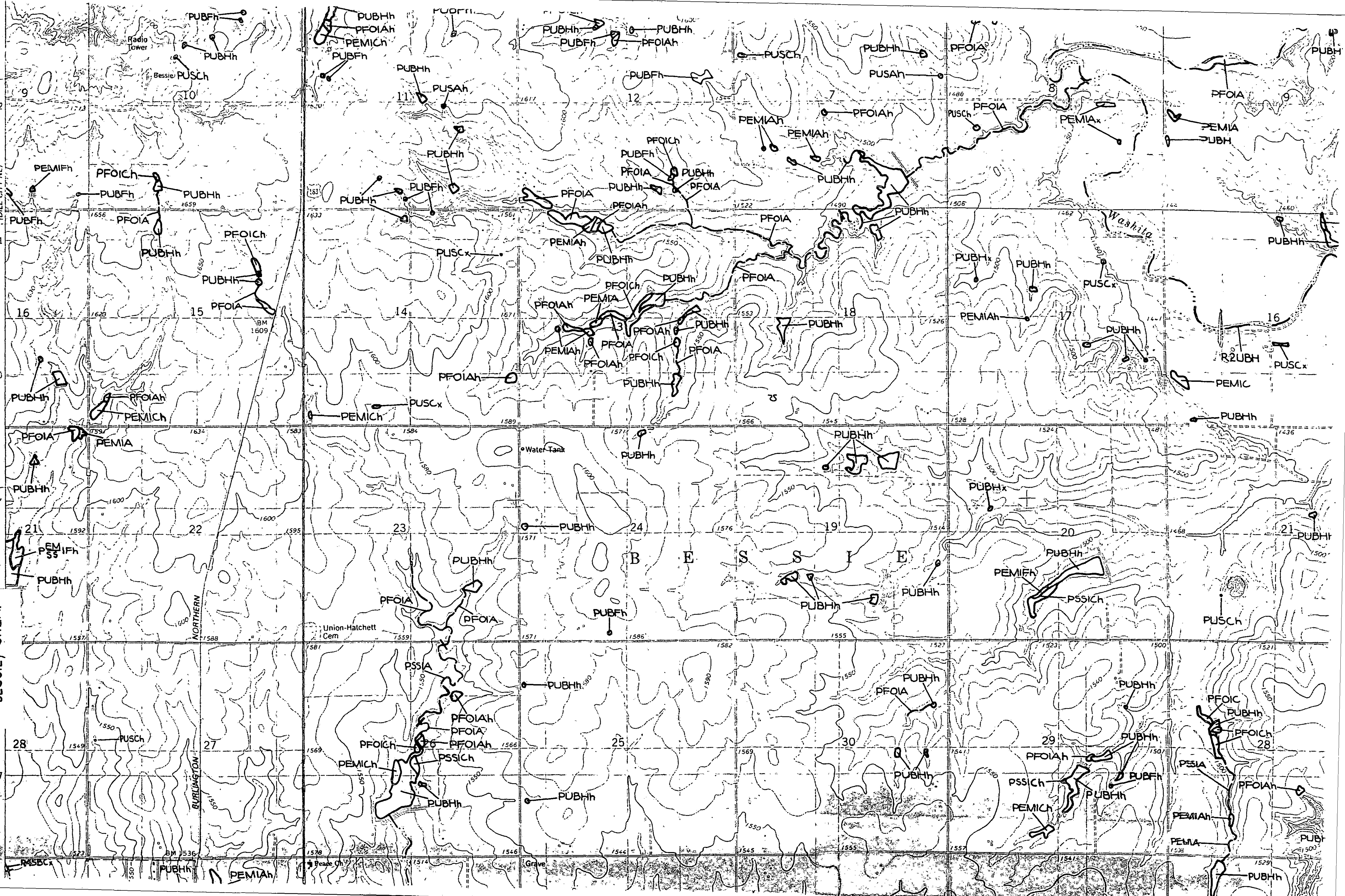
pH Modif all Fresh

- a Acid
- t Circumneutr
- i Alkaline

NATIONAL WETLANDS INVENTORY

UNITED STATES DEPARTMENT OF THE INTERIOR

BESSIE, OKLA.



Radio Tower
Bessie
PUBFh
PUBHh
PFOIAh
PEMICh
PUSCh
PUSAh
PFOICh
PEMIFh
PFOIA
PEMIAh
PEMIA
PEMIAx
PUBHx
PUSCx
PEMIC
R2UBH
PSSIA
PSSICh
PFOIC
R4SBCx
Washita
BM 1609
BM 1536
Water Tank
Union-Hatchett Cem
Peace Ch
Grave
NORTHERN
BURLINGTON
B E S S I E
61541 NE (DILL CITY NE)
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BESSIE, OKLA.

CLINTON, OKLA.

CLINTON, OKLA.

ARAPAHO

Arapaho (BM 1669)

Courthouse

Sew. Disp. Ponds

Radio Tower

Arapaho Cem

Gas Well

Beaver

ATCHISON, TOPEKA AND SANTA FE

R45BA

R45BC

R2UBHx

PUBHh

PUBFh

PUSCh

PUSAh

PFO1A

PFO1Ah

PFO1C

PFO1Ch

PEMIA

PEMIAh

PEMIAx

PEMIC

PEMICh

PSS1C

PSS1Ch

PSS1A

PAB3Hh

PUBFx

PUSCx

PSS1Fh

R2UBH

6155 II SE (STAFFORD)

REFERENCE 21

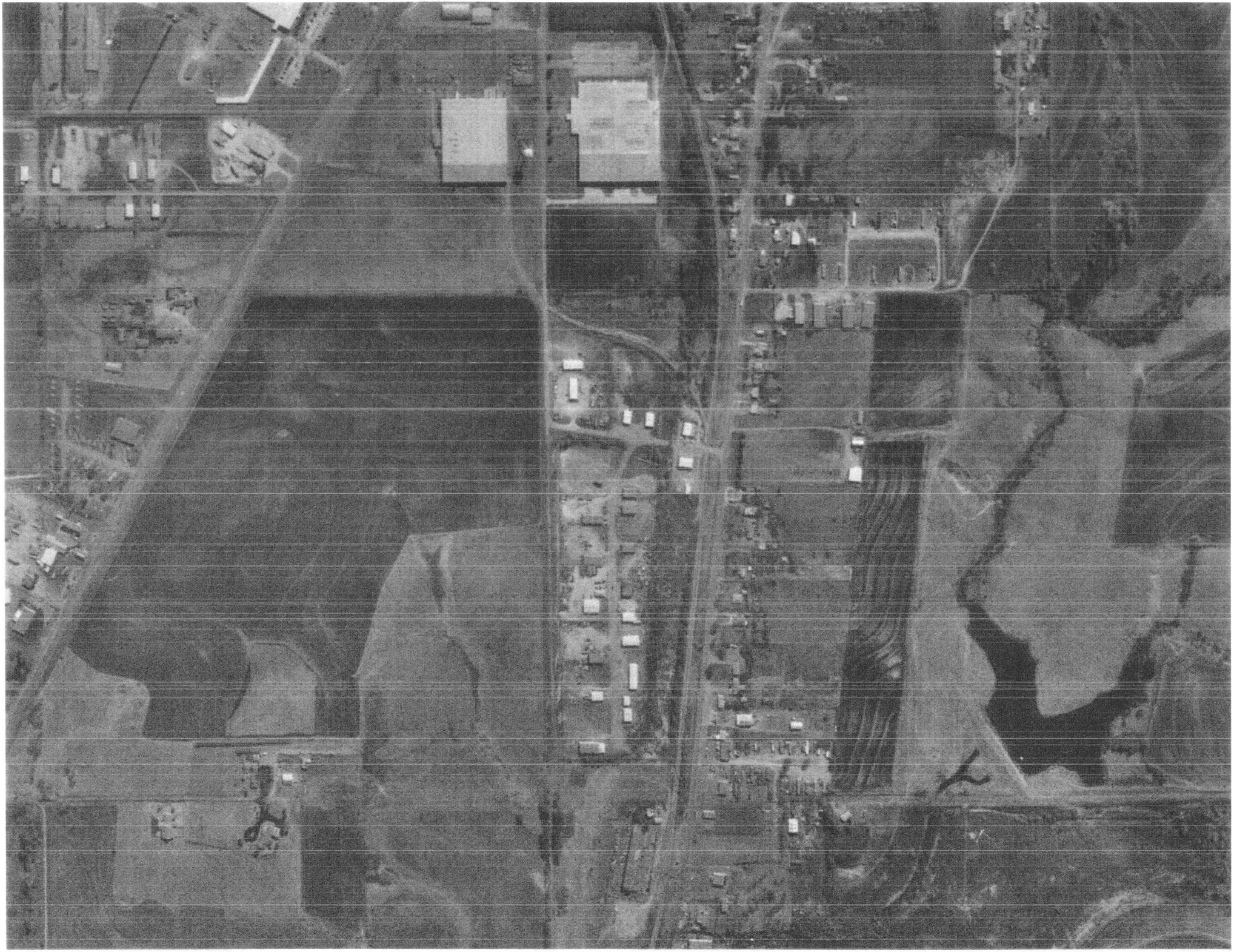
Federal and State Endangered, Threatened and Candidate Species in Oklahoma by County

Species presence based on records in the Oklahoma Natural Heritage Inventory database

County / Organism	Federal	State	Scientific Name	Common Name
ADAIR				
MUSSELS	C	E	LAMPSILIS RAFINESQUEANA	NEOSHO MUCKET
AMPHIBIANS		CS SS2	TYPHLOTRITON SPELAEUS	GROTTO SALAMANDER
		CS SS2	EURYCEA TYNERENSIS	OKLAHOMA SALAMANDER
BIRDS	T	E	HALIAEETUS LEUCOCEPHALUS	BALD EAGLE
MAMMALS	E	E	MYOTIS SODALIS	INDIANA MYOTIS
	E	E	CORYNORHINUS TOWNSENDII INGENS	OZARK BIG-EARED BAT
	E	E	MYOTIS GRISESCENS	GRAY MYOTIS
ALFALFA				
FISH	T	T	NOTROPIS GIRARDI	ARKANSAS RIVER SHINER
BIRDS	T	E	HALIAEETUS LEUCOCEPHALUS	BALD EAGLE
	E	E	STERNA ANTILLARUM	LEAST TERN
	T	SS2	CHARADRIUS ALEXANDRINUS	SNOWY PLOVER
ATOKA				
REPTILES		CS SS2	MACROCHELYS TEMMINCKII	ALLIGATOR SNAPPING TURTLE
BIRDS		SS2	AIMOPHILA AESTIVALIS	BACHMAN'S SPARROW
MAMMALS		SS2	PUMA CONCOLOR	MOUNTAIN LION
BEAVER				
FISH	T	T	NOTROPIS GIRARDI	ARKANSAS RIVER SHINER
	C	SS2	ETHEOSTOMA CRAGINI	ARKANSAS DARTER
REPTILES		CS SS2	PHRYNOSOMA CORNUTUM	TEXAS HORNED LIZARD
BIRDS		SS1	FALCO MEXICANUS	PRAIRIE FALCON
		SS1	BUTEO REGALIS	FERRUGINOUS HAWK
		SS1	AQUILA CHRYSAETOS	GOLDEN EAGLE
	C		TYMPANUCHUS PALLIDICINCTUS	LESSER PRAIRIE-CHICKEN
	E	E	GRUS AMERICANA	WHOOPING CRANE
	E	E	STERNA ANTILLARUM	LEAST TERN

County Organism	Federal	State	Scientific Name	Common Name
MAMMALS		SS2	DIPODOMYS ELATOR	TEXAS KANGAROO RAT
CRAIG				
INSECTS		SS2	GRYLLOTALPA MAJOR	PRAIRIE MOLE CRICKET
FISH	C	SS2	ETHEOSTOMA CRAGINI	ARKANSAS DARTER
REPTILES		CS SS2	MACROCHELYS TEMMINCKII	ALLIGATOR SNAPPING TURTLE
WILDFLOWERS	T		PLATANTHERA PRAECLARA	WESTERN PRAIRIE FRINGED ORCHID
CREEK				
INSECTS		SS2	GRYLLOTALPA MAJOR	PRAIRIE MOLE CRICKET
FISH	T	T	NOTROPIS GIRARDI	ARKANSAS RIVER SHINER
BIRDS	E	E	STERNA ANTILLARUM	LEAST TERN
		SS2	AIMOPHILA AESTIVALIS	BACHMAN'S SPARROW
MAMMALS		SS2	MARMOTA MONAX	WOODCHUCK
CUSTER				
FISH	T	T	NOTROPIS GIRARDI	ARKANSAS RIVER SHINER
REPTILES		CS SS2	PHRYNOSOMA CORNUTUM	TEXAS HORNED LIZARD
BIRDS	T	E	HALIAEETUS LEUCOCEPHALUS	BALD EAGLE
DELAWARE				
MUSSELS	C	E	LAMPSILIS RAFINESQUEANA	NEOSHO MUCKET
CRUSTACEANS		E	CAMBARUS TARTARUS	OKLAHOMA CAVE CRAYFISH
INSECTS		SS2	GRYLLOTALPA MAJOR	PRAIRIE MOLE CRICKET
FISH		SS2	MOXOSTOMA MACROLEPIDOTUM	SHORTHEAD REDHORSE
	T	T	AMBLYOPSIS ROSAE	OZARK CAVEFISH
	C	SS2	ETHEOSTOMA CRAGINI	ARKANSAS DARTER
AMPHIBIANS		CS	EURYCEA LUCIFUGA	CAVE SALAMANDER
		CS SS2	TYPHLOTRITON SPELAEUS	GROTTO SALAMANDER
		CS SS2	EURYCEA TYNERENSIS	OKLAHOMA SALAMANDER
BIRDS	T	E	HALIAEETUS LEUCOCEPHALUS	BALD EAGLE
		SS2	AIMOPHILA AESTIVALIS	BACHMAN'S SPARROW
MAMMALS	E	E	MYOTIS GRISESCENS	GRAY MYOTIS
DEWEY				
FISH	T	T	NOTROPIS GIRARDI	ARKANSAS RIVER SHINER
BIRDS		SS2	ATHENE CUNICULARIA	BURROWING OWL

REFERENCE 22



Okla. Corp. Commission aerial photo database

Okla. GIS Council database, ca. 1996

USGS Digital orthophoto quads

REFERENCE 23

U.S. Census Bureau

State and County *QuickFacts*

QuickFacts Main | FAQs | What's New

Custer County, Oklahoma

Oklahoma counties - view map
Select a county Go

Locate a county by place name

Select a state
USA QuickFacts

Follow the ⓘ link for definition and source information.

Browse more data sets for Custer County, Oklahoma

	People QuickFacts	Custer County	Oklahoma
ⓘ	Population, 2001 estimate	25,358	3,460,097
ⓘ	Population percent change, April 1, 2000-July 1, 2001	-3.0%	0.3%
ⓘ	Population, 2000	26,142	3,450,654
ⓘ	Population, percent change, 1990 to 2000	-2.8%	9.7%
ⓘ	Persons under 5 years old, percent, 2000	6.1%	6.8%
ⓘ	Persons under 18 years old, percent, 2000	24.3%	25.9%
ⓘ	Persons 65 years old and over, percent, 2000	13.7%	13.2%
ⓘ	Female persons, percent, 2000	51.3%	50.9%
ⓘ	White persons, percent, 2000 (a)	81.4%	76.2%
ⓘ	Black or African American persons, percent, 2000 (a)	2.9%	7.6%
ⓘ	American Indian and Alaska Native persons, percent, 2000 (a)	5.8%	7.9%
ⓘ	Asian persons, percent, 2000 (a)	0.9%	1.4%
ⓘ	Native Hawaiian and Other Pacific Islander, percent, 2000 (a)	Z	0.1%
ⓘ	Persons reporting some other race, percent, 2000 (a)	5.8%	2.4%
ⓘ	Persons reporting two or more races, percent, 2000	3.2%	4.5%
ⓘ	Persons of Hispanic or Latino origin, percent, 2000 (b)	9.0%	5.2%
ⓘ	White persons, not of Hispanic/Latino origin, percent, 2000	79.3%	74.1%
ⓘ	Living in same house in 1995 and 2000, pct age 5+, 2000	50.0%	51.3%
ⓘ	Foreign born persons, percent, 2000	3.4%	3.8%
ⓘ	Language other than English spoken at home, pct age 5+, 2000	9.0%	7.4%
ⓘ	High school graduates, percent of persons age 25+, 2000	81.2%	80.6%
ⓘ	Bachelor's degree or higher, pct of persons age 25+, 2000	22.8%	20.3%
ⓘ	Persons with a disability, age 5+, 2000	4,221	676,098
ⓘ	Mean travel time to work, workers age 16+ (minutes), 2000	15.7	21.7
ⓘ	Housing units, 2000	11,675	1,514,400
ⓘ	Homeownership rate, 2000	63.6%	68.4%
ⓘ	Housing units in multi-unit structures, percent, 2000	15.7%	15.2%
ⓘ	Median value of owner-occupied housing units, 2000	$67,800	$70,700
ⓘ	Households, 2000	10,136	1,342,293
ⓘ	Persons per household, 2000	2.45	2.49

	Median household money income, 1999	$28,524	$33,400
	Per capita money income, 1999	$15,584	$17,646
	Persons below poverty, percent, 1999	18.5%	14.7%

	Business QuickFacts	Custer County	Oklahoma
	Private nonfarm establishments, 1999	827	84,854
	Private nonfarm employment, 1999	8,004	1,171,356
	Private nonfarm employment, percent change 1990-1999	5.6%	24.5%
	Nonemployer establishments, 1999	1,707	217,991
	Manufacturers shipments, 1997 ($1000)	D	37,453,197
	Retail sales, 1997 ($1000)	234,992	27,065,555
	Retail sales per capita, 1997	$9,197	$8,166
	Minority-owned firms, percent of total, 1997	F	10.2%
	Women-owned firms, percent of total, 1997	31.8%	24.0%
	Housing units authorized by building permits, 2000	45	11,148
	Federal funds and grants, 2001 ($1000)	124,799	22,671,563
	Local government employment - full-time equivalent, 1997	1,348	129,462

	Geography QuickFacts	Custer County	Oklahoma
	Land area, 2000 (square miles)	987	68,667
	Persons per square mile, 2000	26.5	50.3
	Metropolitan Area	None	

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(a) Includes persons reporting only one race.
(b) Hispanics may be of any race, so also are included in applicable race categories.

FN: Footnote on this item for this area in place of data
NA: Not available
D: Suppressed to avoid disclosure of confidential information
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Z: Value greater than zero but less than half unit of measure shown
F: Fewer than 100 firms

Data Quality Statement

What do you think of QuickFacts?

Source U.S. Census Bureau: State and County QuickFacts. Data derived from Population Estimates, 2000 Census of Population and Housing, 1990 Census of Population and Housing, Small Area Income and Poverty Estimates, County Business Patterns, 1997 Economic Census, Minority- and Women-Owned Business, Building Permits, Consolidated Federal Funds Report, 1997 Census of Governments

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Quick Tables

DP-1. Profile of General Demographic Characteristics: 2000
Data Set: Census 2000 Summary File 1 (SF 1) 100-Percent Data
Geographic Area: **Custer County, Oklahoma**

NOTE: For information on confidentiality protection, nonsampling error, and definitions, see http://factfinder.census.gov/home/en/datanotes/expsf1u.htm.

Subject	Number	Percent
Total population	**26,142**	**100.0**
SEX AND AGE		
Male	12,728	48.7
Female	13,414	51.3
Under 5 years	1,589	6.1
5 to 9 years	1,643	6.3
10 to 14 years	1,823	7.0
15 to 19 years	2,704	10.3
20 to 24 years	3,140	12.0
25 to 34 years	2,819	10.8
35 to 44 years	3,576	13.7
45 to 54 years	3,065	11.7
55 to 59 years	1,186	4.5
60 to 64 years	1,004	3.8
65 to 74 years	1,772	6.8
75 to 84 years	1,279	4.9
85 years and over	542	2.1
Median age (years)	32.7	(X)
18 years and over	19,790	75.7
Male	9,484	36.3
Female	10,306	39.4
21 years and over	17,559	67.2
62 years and over	4,166	15.9
65 years and over	3,593	13.7
Male	1,483	5.7
Female	2,110	8.1
RACE		
One race	25,306	96.8
White	21,283	81.4
Black or African American	751	2.9
American Indian and Alaska Native	1,518	5.8
Asian	229	0.9
Asian Indian	76	0.3
Chinese	30	0.1
Filipino	28	0.1
Japanese	13	0.0
Korean	14	0.1
Vietnamese	45	0.2
Other Asian [1]	23	0.1
Native Hawaiian and Other Pacific Islander	10	0.0
Native Hawaiian	1	0.0
Guamanian or Chamorro	0	0.0
Samoan	3	0.0
Other Pacific Islander [2]	6	0.0
Some other race	1,515	5.8
Two or more races	836	3.2
Race alone or in combination with one or more other races [3]		

Subject	Number	Percent
White	21,998	84.1
Black or African American	915	3.5
American Indian and Alaska Native	2,036	7.8
Asian	298	1.1
Native Hawaiian and Other Pacific Islander	25	0.1
Some other race	1,743	6.7
HISPANIC OR LATINO AND RACE		
Total population	**26,142**	**100.0**
Hispanic or Latino (of any race)	2,361	9.0
Mexican	1,906	7.3
Puerto Rican	24	0.1
Cuban	2	0.0
Other Hispanic or Latino	429	1.6
Not Hispanic or Latino	23,781	91.0
White alone	20,743	79.3
RELATIONSHIP		
Total population	**26,142**	**100.0**
In households	24,878	95.2
Householder	10,136	38.8
Spouse	5,231	20.0
Child	7,063	27.0
Own child under 18 years	5,662	21.7
Other relatives	1,172	4.5
Under 18 years	563	2.2
Nonrelatives	1,276	4.9
Unmarried partner	366	1.4
In group quarters	1,264	4.8
Institutionalized population	520	2.0
Noninstitutionalized population	744	2.8
HOUSEHOLDS BY TYPE		
Total households	**10,136**	**100.0**
Family households (families)	6,581	64.9
With own children under 18 years	3,063	30.2
Married-couple family	5,231	51.6
With own children under 18 years	2,295	22.6
Female householder, no husband present	962	9.5
With own children under 18 years	576	5.7
Nonfamily households	3,555	35.1
Householder living alone	2,817	27.8
Householder 65 years and over	1,095	10.8
Households with individuals under 18 years	3,366	33.2
Households with individuals 65 years and over	2,399	23.7
Average household size	2.45	(X)
Average family size	3.05	(X)
HOUSING OCCUPANCY		
Total housing units	**11,675**	**100.0**
Occupied housing units	10,136	86.8
Vacant housing units	1,539	13.2
For seasonal, recreational, or occasional use	175	1.5
Homeowner vacancy rate (percent)	2.9	(X)
Rental vacancy rate (percent)	11.3	(X)
HOUSING TENURE		
Occupied housing units	**10,136**	**100.0**
Owner-occupied housing units	6,449	63.6
Renter-occupied housing units	3,687	36.4
Average household size of owner-occupied unit	2.57	(X)
Average household size of renter-occupied unit	2.25	(X)

(X) Not applicable
[1] Other Asian alone, or two or more Asian categories.
[2] Other Pacific Islander alone, or two or more Native Hawaiian and Other Pacific Islander categories.
[3] In combination with one or more other races listed. The six numbers may add to more than the total population and the six percentages may add to more than 100 percent because individuals may report more than one race.
Source: U.S. Census Bureau, Census 2000 Summary File 1, Matrices P1, P3, P4, P8, P9, P12, P13, P17, P18, P19, P20, P23, P27, P28, P33, PCT5, PCT8, PCT11, PCT15, H1, H3, H4, H5, H11, and H12.

U.S. Census Bureau

State and County *QuickFacts*

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Washita County, Oklahoma

Oklahoma counties - view map

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Locate a county by place name

Select a state
USA QuickFacts

Follow the ⓘ link for definition and source information.

Browse more data sets for Washita County, Oklahoma

	People QuickFacts	Washita County	Oklahoma
ⓘ	Population, 2001 estimate	11,473	3,460,097
ⓘ	Population percent change, April 1, 2000-July 1, 2001	-0.3%	0.3%
ⓘ	Population, 2000	11,508	3,450,654
ⓘ	Population, percent change, 1990 to 2000	0.6%	9.7%
ⓘ	Persons under 5 years old, percent, 2000	6.1%	6.8%
ⓘ	Persons under 18 years old, percent, 2000	26.3%	25.9%
ⓘ	Persons 65 years old and over, percent, 2000	18.8%	13.2%
ⓘ	Female persons, percent, 2000	51.6%	50.9%
ⓘ	White persons, percent, 2000 (a)	92.3%	76.2%
ⓘ	Black or African American persons, percent, 2000 (a)	0.4%	7.6%
ⓘ	American Indian and Alaska Native persons, percent, 2000 (a)	3.0%	7.9%
ⓘ	Asian persons, percent, 2000 (a)	0.3%	1.4%
ⓘ	Native Hawaiian and Other Pacific Islander, percent, 2000 (a)	Z	0.1%
ⓘ	Persons reporting some other race, percent, 2000 (a)	2.2%	2.4%
ⓘ	Persons reporting two or more races, percent, 2000	1.8%	4.5%
ⓘ	Persons of Hispanic or Latino origin, percent, 2000 (b)	4.5%	5.2%
ⓘ	White persons, not of Hispanic/Latino origin, percent, 2000	90.4%	74.1%
ⓘ	Living in same house in 1995 and 2000, pct age 5+, 2000	59.4%	51.3%
ⓘ	Foreign born persons, percent, 2000	1.6%	3.8%
ⓘ	Language other than English spoken at home, pct age 5+, 2000	5.0%	7.4%
ⓘ	High school graduates, percent of persons age 25+, 2000	79.7%	80.6%
ⓘ	Bachelor's degree or higher, pct of persons age 25+, 2000	15.1%	20.3%
ⓘ	Persons with a disability, age 5+, 2000	2,175	676,098
ⓘ	Mean travel time to work, workers age 16+ (minutes), 2000	21.2	21.7
ⓘ	Housing units, 2000	5,452	1,514,400
ⓘ	Homeownership rate, 2000	74.7%	68.4%
ⓘ	Housing units in multi-unit structures, percent, 2000	3.6%	15.2%
ⓘ	Median value of owner-occupied housing units, 2000	$39,800	$70,700
ⓘ	Households, 2000	4,506	1,342,293
ⓘ	Persons per household, 2000	2.50	2.49

Median household money income, 1999	$29,562	$33,400
Per capita money income, 1999	$15,528	$17,646
Persons below poverty, percent, 1999	15.5%	14.7%

Business QuickFacts	Washita County	Oklahoma
Private nonfarm establishments, 1999	243	84,854
Private nonfarm employment, 1999	1,645	1,171,356
Private nonfarm employment, percent change 1990-1999	11.0%	24.5%
Nonemployer establishments, 1999	748	217,991
Manufacturers shipments, 1997 ($1000)	NA	37,453,197
Retail sales, 1997 ($1000)	46,212	27,065,555
Retail sales per capita, 1997	$3,975	$8,166
Minority-owned firms, percent of total, 1997	F	10.2%
Women-owned firms, percent of total, 1997	17.8%	24.0%
Housing units authorized by building permits, 2000	1	11,148
Federal funds and grants, 2001 ($1000)	85,993	22,671,563
Local government employment - full-time equivalent, 1997	518	129,462

Geography QuickFacts	Washita County	Oklahoma
Land area, 2000 (square miles)	1,003	68,667
Persons per square mile, 2000	11.5	50.3
Metropolitan Area	None	

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(a) Includes persons reporting only one race.
(b) Hispanics may be of any race, so also are included in applicable race categories.

FN: Footnote on this item for this area in place of data
NA: Not available
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Quick Tables

DP-1. Profile of General Demographic Characteristics: 2000
Data Set: Census 2000 Summary File 1 (SF 1) 100-Percent Data
Geographic Area: **Washita County, Oklahoma**

NOTE: For information on confidentiality protection, nonsampling error, and definitions, see http://factfinder.census.gov/home/en/datanotes/expsf1u.htm.

Subject	Number	Percent
Total population	**11,508**	**100.0**
SEX AND AGE		
Male	5,572	48.4
Female	5,936	51.6
Under 5 years	704	6.1
5 to 9 years	759	6.6
10 to 14 years	936	8.1
15 to 19 years	945	8.2
20 to 24 years	552	4.8
25 to 34 years	1,180	10.3
35 to 44 years	1,721	15.0
45 to 54 years	1,418	12.3
55 to 59 years	606	5.3
60 to 64 years	527	4.6
65 to 74 years	1,026	8.9
75 to 84 years	807	7.0
85 years and over	327	2.8
Median age (years)	39.2	(X)
18 years and over	8,486	73.7
Male	4,001	34.8
Female	4,485	39.0
21 years and over	8,046	69.9
62 years and over	2,455	21.3
65 years and over	2,160	18.8
Male	882	7.7
Female	1,278	11.1
RACE		
One race	11,299	98.2
White	10,623	92.3
Black or African American	50	0.4
American Indian and Alaska Native	342	3.0
Asian	30	0.3
Asian Indian	11	0.1
Chinese	4	0.0
Filipino	8	0.1
Japanese	3	0.0
Korean	2	0.0
Vietnamese	2	0.0
Other Asian [1]	0	0.0
Native Hawaiian and Other Pacific Islander	3	0.0
Native Hawaiian	3	0.0
Guamanian or Chamorro	0	0.0
Samoan	0	0.0
Other Pacific Islander [2]	0	0.0
Some other race	251	2.2
Two or more races	209	1.8
Race alone or in combination with one or more other races [3]		

Subject	Number	Percent
White	10,825	94.1
Black or African American	66	0.6
American Indian and Alaska Native	488	4.2
Asian	40	0.3
Native Hawaiian and Other Pacific Islander	9	0.1
Some other race	294	2.6
HISPANIC OR LATINO AND RACE		
Total population	**11,508**	**100.0**
Hispanic or Latino (of any race)	516	4.5
Mexican	382	3.3
Puerto Rican	8	0.1
Cuban	6	0.1
Other Hispanic or Latino	120	1.0
Not Hispanic or Latino	10,992	95.5
White alone	10,406	90.4
RELATIONSHIP		
Total population	**11,508**	**100.0**
In households	11,277	98.0
Householder	4,506	39.2
Spouse	2,748	23.9
Child	3,408	29.6
Own child under 18 years	2,793	24.3
Other relatives	360	3.1
Under 18 years	180	1.6
Nonrelatives	255	2.2
Unmarried partner	123	1.1
In group quarters	231	2.0
Institutionalized population	231	2.0
Noninstitutionalized population	0	0.0
HOUSEHOLDS BY TYPE		
Total households	**4,506**	**100.0**
Family households (families)	3,265	72.5
With own children under 18 years	1,513	33.6
Married-couple family	2,748	61.0
With own children under 18 years	1,187	26.3
Female householder, no husband present	382	8.5
With own children under 18 years	248	5.5
Nonfamily households	1,241	27.5
Householder living alone	1,141	25.3
Householder 65 years and over	604	13.4
Households with individuals under 18 years	1,631	36.2
Households with individuals 65 years and over	1,399	31.0
Average household size	2.50	(X)
Average family size	3.00	(X)
HOUSING OCCUPANCY		
Total housing units	**5,452**	**100.0**
Occupied housing units	4,506	82.6
Vacant housing units	946	17.4
For seasonal, recreational, or occasional use	60	1.1
Homeowner vacancy rate (percent)	7.7	(X)
Rental vacancy rate (percent)	13.0	(X)
HOUSING TENURE		
Occupied housing units	**4,506**	**100.0**
Owner-occupied housing units	3,366	74.7
Renter-occupied housing units	1,140	25.3
Average household size of owner-occupied unit	2.47	(X)
Average household size of renter-occupied unit	2.59	(X)

(X) Not applicable
[1] Other Asian alone, or two or more Asian categories.
[2] Other Pacific Islander alone, or two or more Native Hawaiian and Other Pacific Islander categories.
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Source: U.S. Census Bureau, Census 2000 Summary File 1, Matrices P1, P3, P4, P8, P9, P12, P13, P17, P18, P19, P20, P23, P27, P28, P33, PCT5, PCT8, PCT11, PCT15, H1, H3, H4, H5, H11, and H12.

REFERENCE 24

PRELIMINARY ASSESSMENT
RAY WICHERT PROPERTY
CL TON, OKLAHOMA

July 29, 1992

OKLAHOMA STATE DEPARTMENT OF HEALTH

Prepared By

Tim Daly, University of Oklahoma Intern

Reviewed & Approved By

Richard L. Brooks, Sr. Environmental Specialist

Reviewed By:____

DATE_____

Table of Contents

I. Introduction

The Oklahoma State Department of Health (OSDH) is tasked by the U.S. Environmental Protection Agency (EPA), as authorized by CERCLA and as amended by SARA, under the Multi-Site Cooperative Agreement (CA# V-00645-01) to conduct a preliminary assessment (PA) of the Ray Wichert Property (CERCLIS ID# not yet assigned). As depicted in Figure 1 (Reference 1), this site is approximately a one mile south of the City of Clinton, Custer County, Oklahoma. The primary purpose for this PA is to assess the immediate or potential threat of wastes at the site that may have an impact on public and environmental health and to collect information sufficient to support a decision regarding the need for further action under CERCLA/SARA. The scope of this investigation includes the review of available information from the OSDH files and conducting a comprehensive target survey.

II. Site Description, Operational History, and Waste Characteristics

Site Description

The Ray Wichert Property is primarily located in the NE4 SEC27 T12N R17W I.M. CUSTER COUNTY OK (Reference 1, 2). The two (2) acre site has the coordinates of 35° 29' 24.38" north latitude and 98° 58' 41.03" west longitude (Reference 2). The site is a little less than one (1) mile south of the City of Clinton. The dump is not active and is currently owned by the Oklahoma Bank and Trust Company of Clinton, Oklahoma. (Reference 3, 4). The Ray Wichert Property had apparently operated as a dump between 1969 to 1987 (Reference 3). The site is in a commercial setting (Reference 3). The nearest residence is approximately one tenth (1/10) of a mile directly west of the site (Reference 1, 3). The nearest active domestic well is approximately two and a half (2 1/2) miles to the northeast of the site (Reference 1).

Operational History

According to the Quit Claim Deed dated 10/12/87 between Ray Wichert, Peggy Jo Wichert, and Wic-Hert Inc., and Oklahoma Bank and Trust Company of Clinton, Oklahoma, the property, approximately 2.0 acres with a fill of 6 to 8 feet deep, is now owned by the Oklahoma Bank and Trust Company (Reference 4). The person who apparently owned the property originally was Earl Smith. Mr. Smith went bankrupt and Ray Wichert acquired the property. Mr. Wichert then too went bankrupt and had to relinquish the land. The property was then finally sold at an auction on August 25, 1987 to the Oklahoma Bank and Trust Company of Clinton Oklahoma. They currently retain ownership of the property (Reference 4).

At the time of construction, the site had been excavated and was apparently around fifteen (15) feet lower than the east boundary which runs parallel to the railroad track (Reference 3). The property has been used "in the past" as a disposal site for concrete, construction, and asphalt in the City of Clinton. The site has presumably been contaminated with radium by rubble left from a airplane dial refurbishing plant called Sooner Dial Co. of Clinton which is

approximately one (1) mile from the site. Sooner Dial Co. used paint containing radium due to its luminous characteristics. Mr. Grubb, ıe owner of the Sooner Dial Co. property claims that he hired Sugar Creek Transport, owned by Bill Warner, to haul the rubble off, and that it was Warner who chose to take it to the Ray Wichert Property. According to Mr. Grubb, the "rubble site" was owned by Earl Smith, who openly allowed people to dump dirt, etc. The drainage of surface water is to the north toward the intermittent water course. Multiple samples were taken from the site at different times to determine the extent of contamination on the property. In all of the tests, the results conveyed that the levels of contamination were high enough to warrant removal (Reference 4).

On September 24, 1990, the OSDH sent a letter to the Oklahoma Bank and Trust Company informing the bank of its responsibility to remediate the radiation waste on the property they own, referred to as the "Sooner Dial Co. Rubble site". However, Al Wood, Vice-President of Oklahoma Bank and Trust, disagrees with the claim that they are responsible for the cost of an environmental assessment without "something more than speculation" as to possible contamination. However, field data taken in the past shows a concern for levels of radiation on site (Reference 4).

Waste Characteristics

There are multiple sources of concern that need to be identified and remediated. The first source is the radium contamination due to its radioactivity and its toxicity. There were numerous areas that had elevated readings of radioactivity (Reference 5). The rubble is located within an approximate one acre area of the site (Reference 3). The majority of the rubble is assumed to be from the Sooner Dial Co. site (Reference 3).

Radium is a radioactive earth metal that is brilliant white and tarnishes in air. It decomposes in water and has a melting point of 700° Fahrenheit and a boiling point of 1737° Fahrenheit. It is highly dangerous, and must be kept heavily shielded and stored away from possible dissemination by explosion, flood, ect. It is considered to be a common air contaminant and a highly radiotoxic element. Inhalation, ingestion, or bodily exposure to radium can lead to lung cancer, bone cancer, osteitis, skin damage and blood dyscrasias (Reference 5). Radium replaces calcium in the bone structure and is a source of irradiation to the blood forming organs. The ingestion of luminous dial paint prepared from radium was the cause of death of many of the early dial painters before the hazard was fully understood. ^{226}Ra decays to ^{222}Rn via alpha waves and therefore is considered the parent of radon (Reference 5).

The next source of concern are drums that were found on sight. There were six (6) unmarked drums. The majority of the drums were obviously under pressure and had expanded, but at least one of the drums had ruptured and had leaked an unknown substance. Stressed vegetation marked the area where the leaking had occurred (Reference 3). The final source of con-

cern is a removed underground storage tank (UST) that was above ground. It was estimated to be a 5000 gallon tank. It is unknown if the tank ever had or does contain any hazardous materials (Reference 3).

III. Pathway and Environmental Hazard Assessment

Groundwater

The site, at the time of construction, had been lowered apparently fifteen feet as compared to the west embankment and been covered with a layer of clay. The depth of the clay has not been determined. Under this clay is a layer known as the Terrace Deposits. Terrace Deposits are stream-laid deposits of sand, silt, clay, gravel, and volcanic ash. Its thickness ranges from 0 to about 120 feet. Underlying the Terrace Deposits is the Cloud Chief Formation. It is characterized as being a reddish-brown to orange-brown shale, interbedded with siltstone and sandstone in the middle part and some dolomite and much gypsum in the lower part of the formation. Its thickness is around 400 feet, thinning northward to about 175 feet. The Whitehorse Group forms the next underlying layer. The Whitehorse Group is predominantly orange-brown, fine-grained sandstone. The Rush Springs Formation and the Marlow Formation comprise the Whitehorse Group. The Rush Springs Formation ranges in thickness from 300 feet, thinning northward to about 186 feet. The Marlow Formation, although not as thick, ranges from 100 to around 130 feet thick, gradually thinning to the north. This formation has 2 gypsum and (or) dolomite beds in the upper 20 feet of the formation. Two thin, pink shales occur. The first is about 1 foot below the top and the second is about 55 feet above the base. In the middle of the formation about 25 feet below the previously mentioned gypsum layers and about 85 to 95 feet above the base is the Verden Sandstone Lentil. It is a coarse-grained, calcareous, fossiliferous sandstone. (Reference 6)

Aquifers are associated with the Terrace Deposits and the Rush Sandspring Formation, and in the vicinity of the site, they; therefore, will be viewed as one aquifer for the duration of this report. Along large streams, deposits consist of clay and silt at the surface which form the Terrace Deposits. It then grades downward into coarse sand and gravel at the base. Water is available from saturated layers of sand and gravel, and yields are highest where the coarse sand and gravel layers are thickest. In areas where an alluvium or terrace aquifer overlies the Rush Springs Sandstone, water is available from either aquifer. In the vicinity of the site the deposits are thin and yields an average 280 gallons per minute (gpm). The Rush Springs Sandstone consists mainly of fine-grained sandstone with some dolomite, shale, and gypsum beds. The Marlow Formation, which is inclusive with the Rush Springs Formation, consists of fine-grained sandstone with much gypsum and shale. The bedrock aquifer in the vicinity of the site is thick, but is assumed to be relatively close to the surface. In addition, it yields an average of 14 gallons per minute (gpm) at the nearest vicinity of the site (Reference 6).

There are private water wells within the area of interest (Reference 3, 7). Populations served by private wells are described below (References 7). The nearest well used for drinking water is about two and a half (2 1/2) miles to the northeast from the site, serving an estimated population of 2.55 (Reference 3, 7, 8, 9). Based on above information, all groundwater users are considered secondary targets.

Distance from Site (mi)	Estimated Populations Served by Private Wells
On-site	0
0 - 1/4	0
1/4 - 1/2	0
1/2 - 1	0
1 - 2	0
2 - 3	2.6
3 - 4	5.1
Total	**7.7**

Surface Water

The nearest perennial stream is just greater than two miles away from the site following the surface water migration route. Accordingly, there is not considered to be a probable point of entry (PPE). Although the general vicinity of the site is outside the flood plane, the site itself might actually be within the 500 year flood plane due to its lowered elevation (Reference 3, 10, 11). The normal annual total precipitation in the site's region is about 25 inches per year (Reference 6).

There are no active surface water intakes located within the 15 mile target distance. Due to the excavated nature of the site, it is possible for the site to be in the flood plane and therefore could have the endangered species habitats associated with it. Habitats of the endangered/threatened species listed below are known to be in Custer County, however; it is unknown if any of these habitats are actually associated with the surface water migration route (Reference 12).

Species	*Federal Status*
Bald eagle	Endangered
Whooping crane	Endangered
Interior least tern	Endangered
Peregrine falcon	Endangered
Arkansas River shiner	Candidate
Arkansas River speckled chub	Candidate
Texas horned lizard	Candidate
White-faced ibis	Candidate
Ferruginous hawk	Candidate
Long-billed curlew	Candidate
Western Snowy plover	Candidate

Soil Exposure

As per the PA Guidance Document, on-site soil contamination is assumed. The site is non-active. There is no one currently working on site (Reference 3). There are no residences, schools, day-care centers within 200 feet or within the site-boundaries (Reference 1, 3, 4). Due to the lack of information, it is assumed (as per the PA Guidance Document) that all of Custer County's terrestrial endangered/threatened species listed under the surface water pathway are on-site (Reference 12).

Air

Due to the composition of the rubble, the heavy vegetation associated with the area, and the excavated landscape, an air release is not suspected. The estimated population and wetland acreage within 4 miles from the site is described below (References 1, 3, 7, 8, 9, 13). There are no "designated" wetlands on-site (Reference 11). As per the PA Guidance Document, it is assumed that the all of Custer County's endangered/threatened species, listed under the surface water pathway, have habitats on site (Reference 12). In addition the prairie mole cricket, which is located in Washita county, could possibly be as near as 1 3/4 miles from the site (Reference 1,12).

Distance from Site (mi)	Estimated Residing Population	Estimated Wetland Acreage
On-site	0	0
0 - 1/4	71.4	1
1/4 - 1/2	63.8	2.5
1/2 - 1	1969	9
1 - 2	3703	40
2 - 3	3124	60
3 - 4	140.3 (Custer) 50.6 (Washita)	75
Total	**9122.1**	**187.5**

IV. Summary and Conclusion

An excavated area in Custer County, Oklahoma had operated as a dump site apparently between 1969 to 1987. The site is known to contain rubble contaminated with radioactive radium, six unlabeled drums, and an unearthed underground storage tank; therefore, the surface may be adversely effected. The surface water has a potential for contamination via floods which poses a threat to the environment and to human targets through food chain contamination. The site is inactive and is heavily vegetated; therefore, the likelihood of human exposure via soil and air is probably minimal. Additionally, the groundwater pathway is also of minimal concern because the nearest domestic well is over two miles from the site.

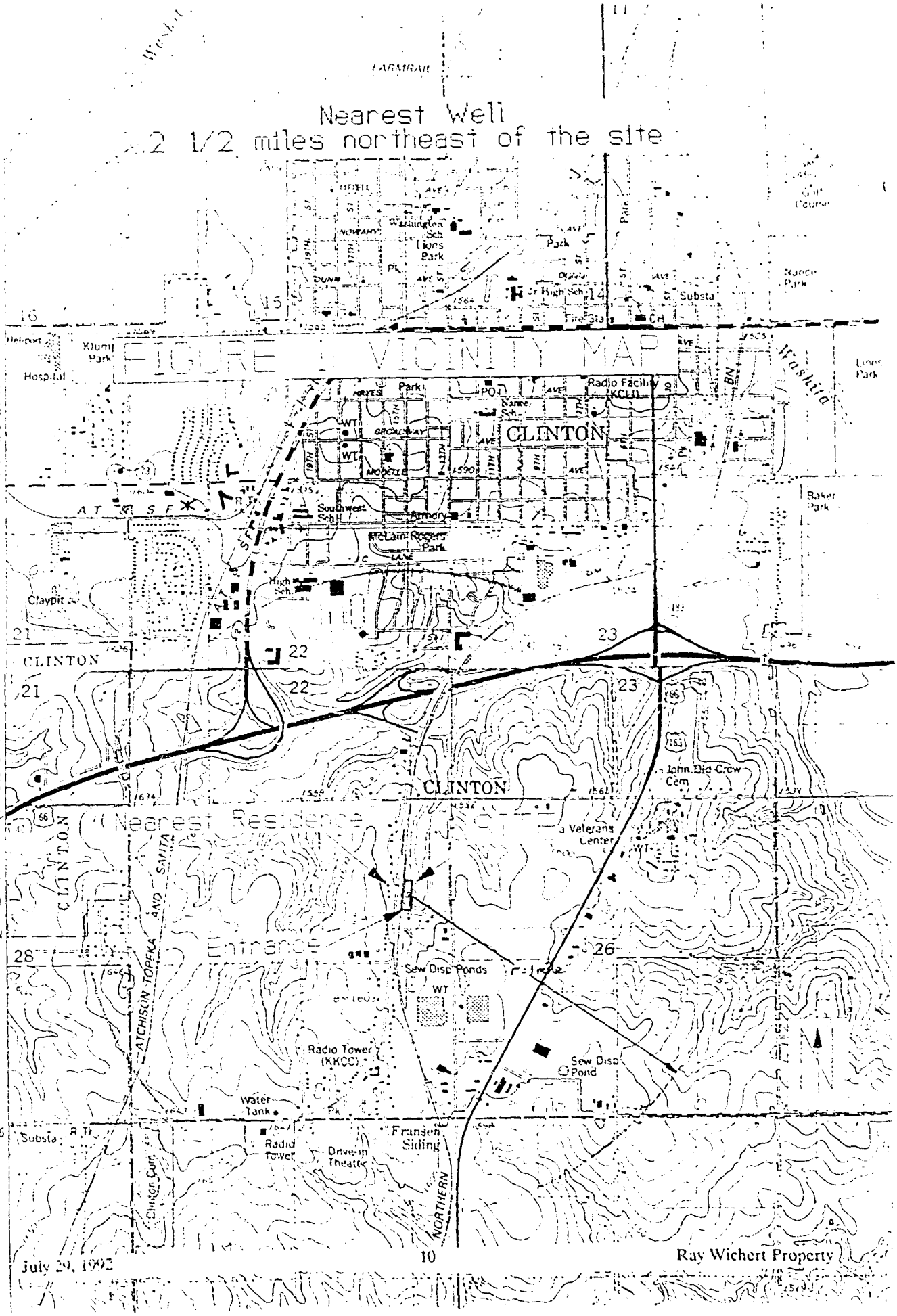

Nearest Well
2 1/2 miles northeast of the site
FIGURE 2 VICINITY MAP
CLINTON
Nearest Residence
Entrance
Ray Wichert Property
July 29, 1992
10

Figure 2: Site Map

NOT TO SCALE

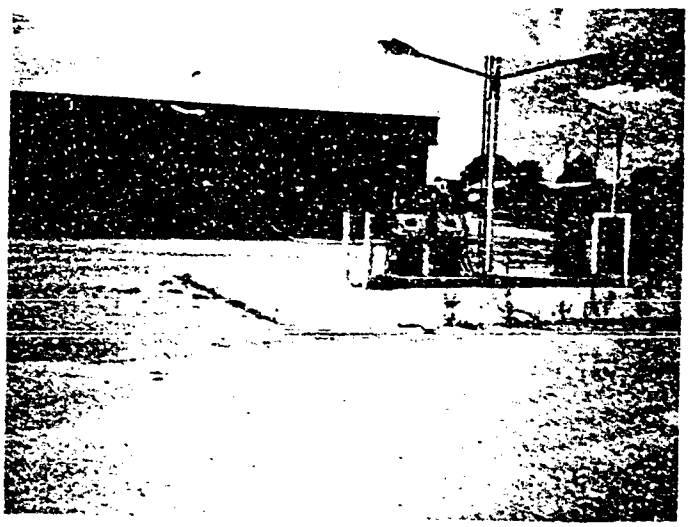
Photographer: Richard L. Brooks **Witness:** Tim Daly
Date: July 15, 1992 **Direction:** northwest

Comments: Photograph #1 (matches slide # 3). Picture is of an unearthed underground storage tank on site.

Photographer: Richard L. Brooks **Witness:** Tim Daly
Date: July 15, 1992 **Direction:** west

Comments: Photograph #3 (matches slide # 13). Picture is of six (6) unlabeled drums and stressed vegetation associated with a leaked substance from the drums.

Photographer: Richard L. Brooks **Witness:** Tim Daly
Date: July 15, 1992 **Direction:** south

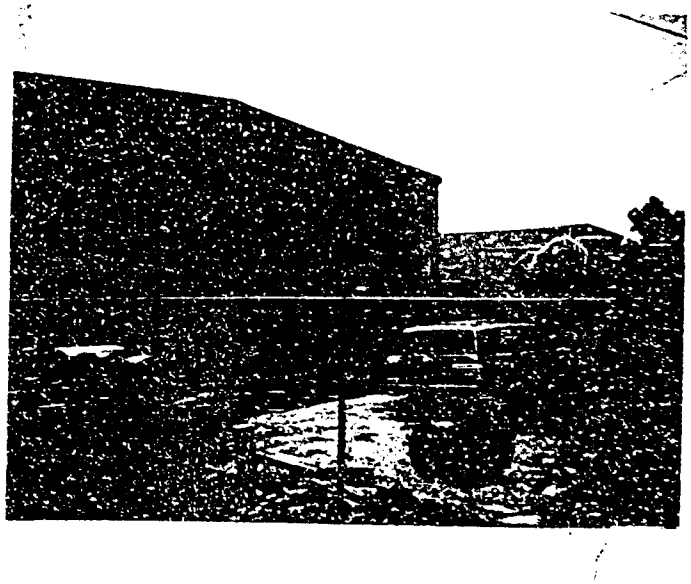


Comments: Photograph #4 (matches slide # 15). Picture is of three (3) fuel islands and an apparently inactive semi-truck repair and cleaning facility.

Photographer: Richard L. Brooks **Witness:** Tim Daly
Date: July 15, 1992 **Direction:** northwest

Comments: Photograph #5 (matches slide # 17). Picture is of the nearest residences across Tenth Street and the Burlington Northern Railroad.

Photographer: Richard L. Brooks **Witness:** Tim Daly
Date: July 15, 1992 **Direction:** southeast



Comments: Photograph #6 (matches slide # 19). Picture is of the nearest apparently active facility 66 Music and Vending Inc.

VII. List of References

1. U.S. Geological Survey. 7.' minute topographic quadrangle maps of: Clinton, Okla. 1983. Bessie, Okla. 1983. Dill City NE, Okla. 1983. Stafford, Okla. 1983.

2. Karen Khalafian. USEPA. Standard Operating Procedure to Determine Site Latitude and Longitude Coordinates. April 28, 1992. Calculation Worksheet for the Ray Wichert Property.

3. Tim Daly, University of Oklahoma Intern. *Memorandum:* Reconnaissance of the Ray Wichert Property - Clinton, Oklahoma. July 15, 1992.

4. Tim Daly, University of Oklahoma Intern. *Memorandum:* Operational History. July 13, 1992l.

5. N. Irving Sax. *Dangerous Properties of Industrial Materials 6th edition.* Copyright 1984.

6. Oklahoma Geological Survey. *MAPS HA-5 Reconnaissance of the Water Resources of the Water Resources of the Clinton Quadrangle. West-Central Oklahoma.* The University of Oklahoma, Norman. 1976.

7. Tim Daly, University of Oklahoma Intern. *Memorandum:* To Ray Wichert Property PA Air and Groundwater Targets. July 16, 1992.

8. United States Department of Commerce. *Selected Population and Housing Characteristics: 1990.* Custer and Washita Counties, Oklahoma.

9. GEMS-1980 Population Data for Ray Wichert Property. Compiled by RLB, OSDH. May 12,1992.

10. Ken Morris, the Oklahoma Water Resources Board to Richard L. Brooks. *RE. A request letter dated May 14, 1992 regarding flood planes*

11. U.S. Department of the Interior, Fish and Wildlife Service. 7.5 minute wetland quadrangle maps of: Clinton, Okla. 1990. Bessie, Okla. 1990. Dill City NE, Okla. 1990. Stafford, Okla. 1990.

12. U.S. Fish and Wildlife Service. *Oklahoma Federal Listed and Proposed and Candidate Threatened and Endangered Species.* Custer County. June 1990.

13. Karen Khalafian. *Wetland Acreage Worksheet. Sheet: Ray Wichert Property.* June 22, 1992.

REFERENCE 25

MEMORANDUM
April 23, 1986

TO: Dale McHard, Chief
Radiation and Special Hazards Service

FROM: Robert L. Craig, Director RLC
Radiation Protection Division

SUBJECT: Radium Contamination on Ray Wichert Property in Clinton, Oklahoma

On April 15, 1986 I took soil samples on the subject property for the purpose of evaluating the degree of radium contamination. I was accompanied by Terry Thiesson and Bob Giger, Custer County sanitarians. Mr. Wichert was not available to accompany us.

The property is on the south side of Clinton and lies just east of U.S. Highway 83 (map attached). On the west side of the property is a railroad track. On the east side is an intermittent water course which drains to the north. On the south side is a car wash. The level of the property is about six feet below the level of the adjoining property.

The property has been used in the past as a disposal site for concrete, asphalt, and dirt from construction sites in the City of Clinton. This debris is in piles up to three feet high which are fairly evenly distributed over the property. The large pieces of concrete and other construction debris prevented easy access to parts of the site. The drainage of surface water is to the north toward the intermittent water course. The soil is thin, estimated to one or two inches above the underlying sandstone.

The property was surveyed with the 1 X 1 inch NaI detector and the background radiation was found to be about 10 microroentgen per hour (micro R/hr) which is normal for that area in Oklahoma. There were spots in the area where the radiation levels were found to be in excess of 100 micro R/hr. These levels were found in the vicinity of some piles of debris and in the area over which drainage from the piles would have passed.

A rough sketch of the area is attached. The piles of debris near which elevated external gamma radiation levels were found are identified as A, B, C, D, F, and G. The drainage area which was sampled is identified as E.

Samples were taken with a 3/4 inch diameter core sampler which was 8 inches long. At the location where it was possible to obtain an 8 inch core, the samples were divided into two portions, surface to four inches depth and four to eight inches depth, which were analyzed separately. For purposes of comparison a similar sample was collected from the lawn of the State Health Department.

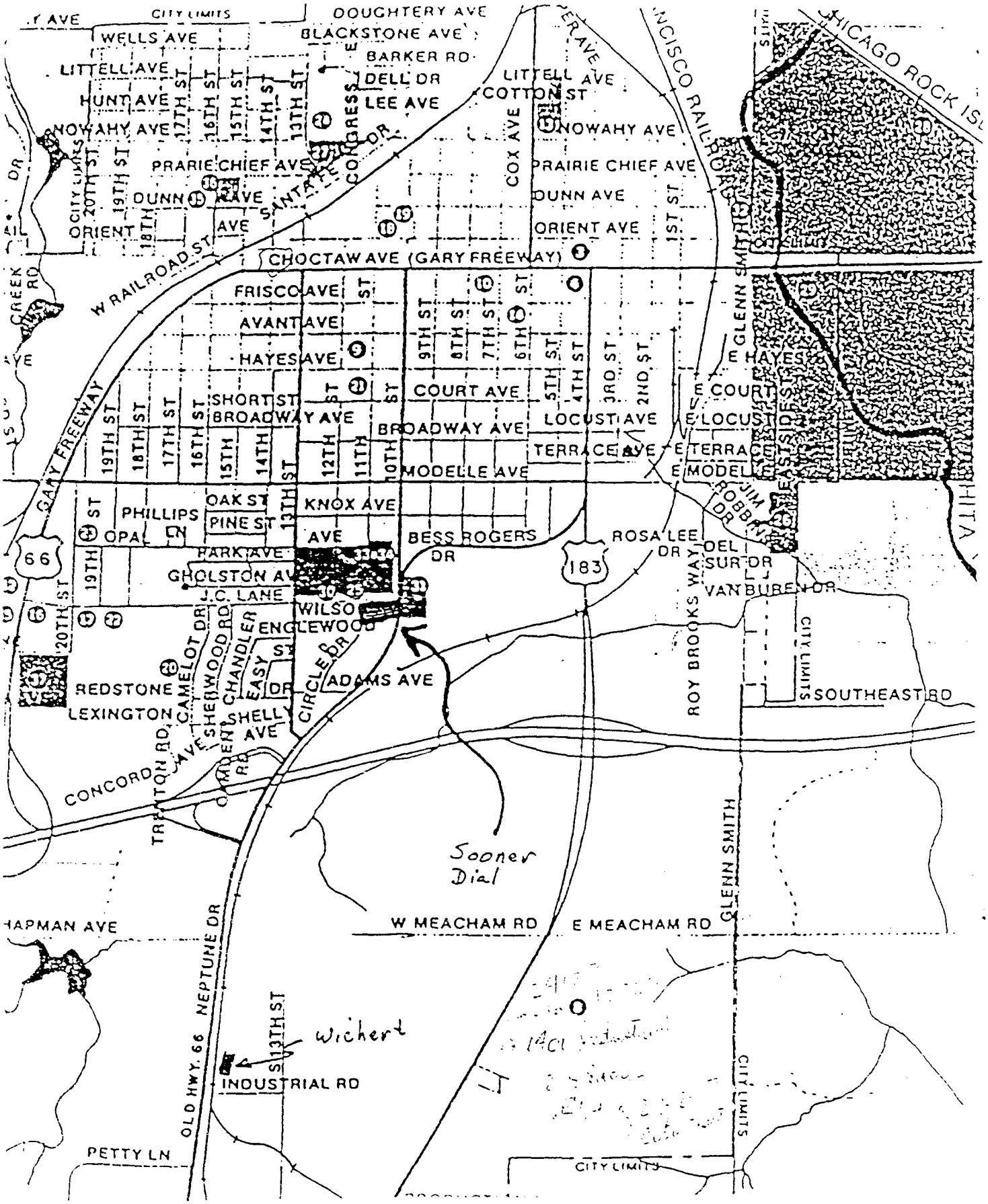
The results of the analyses were:

Sample Point	Depth (inches)	Radium (p Ci/gm)
A	0-4	23
A	4-8	33
B	0-4	49
B	4-8	163
C	0-4	27
D	0-4	149
E	0-1	113
F	0-4	37
F	4-8	67
G	0-4	63
OSDH	0-4	< 4
Shield Background	—	< 4

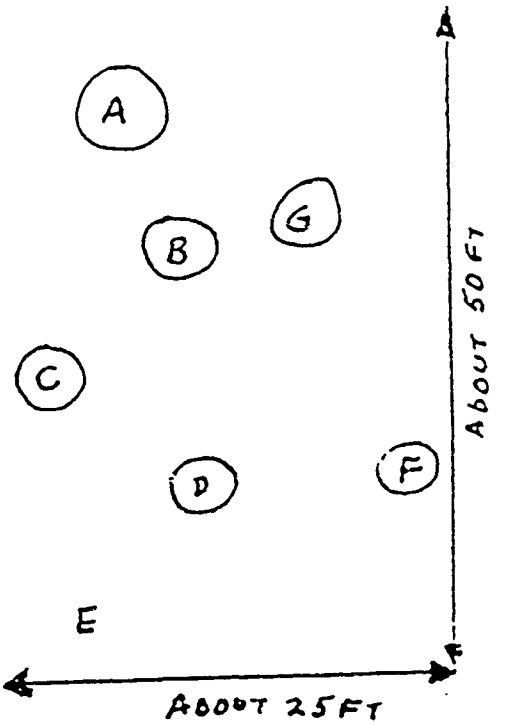
Minimum Detectable Concentrations - 4 pCi/gm

Attachments

cc: Terry Thiesson


CITY LIMITS
WELLS AVE
LITTELL AVE
HUNT AVE
NOWAHY AVE
PRAIRIE CHIEF AVE
DUNN AVE
ORIENT AVE
DOUGHTERY AVE
BLACKSTONE AVE
BARKER RD
DELL DR
LEE AVE
COTTON ST
COX AVE
SANTA FE CORRIDOR
CHICAGO ROCK ISL
W RAILROAD ST
CHOCTAW AVE (GARY FREEWAY)
FRISCO AVE
AVANT AVE
HAYES AVE
COURT AVE
BROADWAY AVE
LOCUST AVE
TERRACE AVE
MODELLE AVE
E HAYES
E COURT
E LOCUST
E TERRACE
E MODEL
GARY FREEWAY
SHORT ST
OAK ST
PINE ST
KNOX AVE
PHILLIPS
OPAL LN
PARK AVE
GHOLSTON AV
J.C. LANE
BESS ROGERS DR
ROSA LEE DR
DEL SUR DR
VAN BUREN DR
WILSON
ENGLEWOOD
CHANDLER
EASY ST
DR
ADAMS AVE
CIRCLE DR
CAMELOT DR
SHERWOOD RD
REDSTONE
LEXINGTON
SHELLY AVE
CONCORD RD
TRENTON AVE
CLARENT RD
ROY BROOKS WAY
SOUTHEAST BD
CITY LIMITS
Sooner Dial
W MEACHAM RD
E MEACHAM RD
GLENN SMITH
HAPMAN AVE
NEPTUNE DR
OLD HWY. 66
S 13TH ST
Wichert
INDUSTRIAL RD
PETTY LN
66
183

S
1



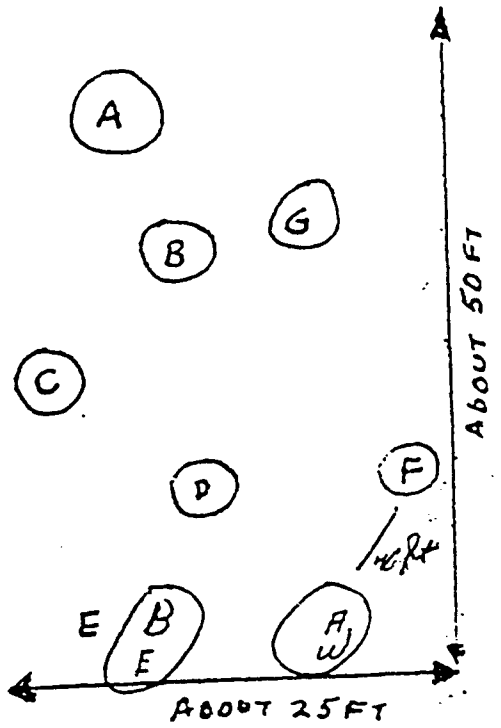
Source 5.

Wichert Property
Clinton, OK

Sample Collection Points

15-APR-86
RLC

S
1



Samples taken on 4-15-86 and is mentioned in 4/23/86 memo from Robert Craig to Dale McHard

Wichert Property
Clinton, OK

Sample Collection Points

15-APR-86
R.C.

I picked up these two samples before the drop off at Hart's. Of the lot roughly 40 feet NE from point F W & BF sites are about 15 feet apart

Tibby D. Thurman

REFERENCE 26

OKLAHOMA CORPORATION COMMISSION
PETROLEUM STORAGE TANK DIVISION
(405) 521-4683 FAX: (405) 521-4945

JIM THORPE BLDG, ROOM 238 • P.O. BOX 52000-2000 • OKLAHOMA CITY, OKLAHOMA 73152-2000

March 25, 1999

Oklahoma Bank & Trust
P.O. Box 99
Clinton, OK 73061

Reference: Petroleum storage tank amended notification form for permanent tank closure of 2-12,000 gallon, and 1-20,000 gallon underground storage tank(s) (UST(s)) located at 1401 Industrial Road, Clinton, Oklahoma. Facility #2014103.

Dear Sir:

Thank you for providing your amended notification form and supporting information documenting the permanent closure of your UST(s) at the above referenced facility to the Oklahoma Corporation Commission (OCC).

Based on the information you have provided regarding current site conditions, the OCC believes that there is no contamination of concern at this site at this time. The subject tank(s) is/are hereby considered permanently closed in accordance with OCC UST regulations. Should future environmental problems occur, which the OCC determines are related to this site, additional investigation and corrective action may be required in accordance with State Law.

If you have any questions regarding this matter, please contact me at (405) 521-6397 (phone) or (405) 636-3501 (pager).

Sincerely yours,

Bryan Morris

Bryan Morris
Environmental Compliance Analyst

cc: Facility file #2014103
James Roberts

out MS

TANK CLOSURE SUMMARY SHEET

FACILITY ID NUMBER: 2014103
CASE NUMBER (if applicable): _____

Comments: _____

Number of USTs at facility (reported): 3
Number of USTs at facility (actual): 3
Number of USTs being closed: 3

OWNER/OPERATOR:

NAME	JOB TITLE	ADDRESS	PHONE #
Oklahoma Bank + Trust		P.O. Box 99, Clinton OK 73601	

TANK ID #:	TANK NO. 1	TANK NO. 2	TANK NO. 3	TANK NO.
EST DATE LAST USED:	?	?	?	
EST TANK CAPACITY (gal):				
FAC DATABASE	12,000	12,000	20,000	
AFTER CLSR REVIEW	12,000	12,000	20,000	
TANK REMOVED (Date):	12-30-98	12-30-98	12-30-98	
TANK CLSD IN GRD(Date):				
TANK FILLED WITH:				

SCHEDULED CLOSURE: Yes X ; No _____

SITE ASSESSMENT COMPLETED: Yes X ; No _____

•TESTING (SOIL) OR GW:

•USING EXTERNAL LEAK DETECTION:
VAPOR MW _____; GROUNDWATER MW _____.

EVIDENCE OF LEAK DETECTED: Yes _____; No X.

NUMBER OF NEW TANKS INSTALLED (see attached 7530 for details): 0

Bryan Morris
Technical Staff Reviewer

3-25-99
Date

B

MG

RECEIVED
UST/AST Dept.
FEB 09 1999
Oklahoma Corporation Commission

OKLAHOMA CORPORATION COMMISSION
Fuel Division, UST/AST Program
P.O. Box 52000-2000
Oklahoma City, OK 73152-2000
(405) 522-4640

CLOSURE REPORT
FOR
PERMANENTLY CLOSED UNDERGROUND STORAGE TANKS

PLEASE SUBMIT THIS COMPLETED FORM ALONG WITH ATTACHMENTS WITHIN 45 DAYS OF THE SCHEDULED CLOSURE.

1. **Facility Identification Number.** ~~Unregistered~~ 20141103

2. **Facility Location Name and Address.**
   Unnamed Site (vacant)
   1401 Industrial Road
   Clinton, OK

3. **Owner's Name and Address.**
   Oklahoma Bank & Trust
   P.O. Box 99
   Clinton, OK 73061

4. **Date Work Accomplished.** 12/30/98

5. **Number and size of tanks remaining at this facility.**
   None

6. **Number and size of tanks removed.** 1 - 20,000 gal. 2 - 12,000 gallon

   (a) **Condition of removed tanks. Are there any holes present?**
   No holes observed. Tanks heavily corroded & pitted

   (b) **Describe the disposal and/or disposition of the tank(s).**
   To be hauled off and used as culverts & scrap iron. See attached certificate of disposal

   (c) **If tank system consisted of pressure piping, were samples taken at least every 40 feet?** No. Piping runs less than 40 feet.

   (d) **Was excavated soil removed from the site?** No

   (e) **If so, was a permit obtained for its removal?** N/A

7. **Number and size of tanks filled with inert material.** N/A

8. **Estimated date tanks were last used.** Unknown

9. Assess the site for potential contamination by:
   (a) testing the soil or groundwater; or — Soil samples collected for chemical analysis
   (b) using an external leak detection method such as monitoring wells.
   (c) Were field screening instruments used? Yes
   (d) If so, what was the type and model number? Thermo Environmental Instruments Model 580B OVM

NOTE: If soil or ground water samples are used for a site assessment, the person taking the samples must be under the supervision of or be a certified UST Consultant.

10. Certified UST Consultant responsible for the sampling.
    I certify the samples were taken at locations where contamination had most likely occurred.
    Name James W. Roberts, Enercon Services, Inc.
    Address 6525 N. Meridian, Suite 214
    Oklahoma City, OK 73116
    Phone Number (405) 722-7693
    Certification Number 0293

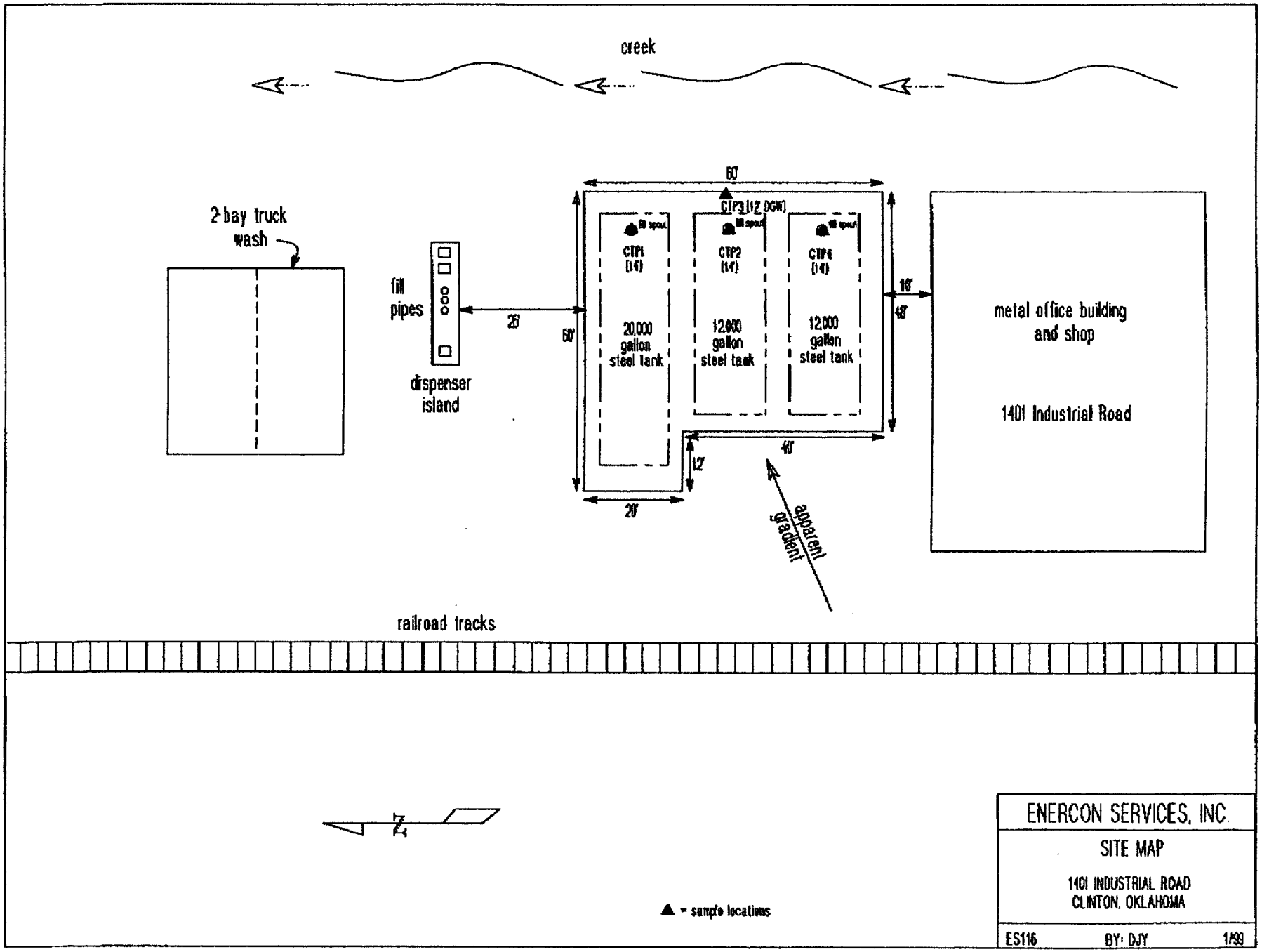
    Signature of Oklahoma Certified UST Consultant:
    James Roberts Date 1/25/99

11. A site sketch shall include:
    (a) North arrow
    (b) Tank pit location
    (c) Proximity of tank pit to roads, buildings, or other landmarks measured in feet
    (d) Piping layout and pump island location
    (e) Soil sample locations identifying the sample identification

12. Site Assessment prepared by:
    Name James W. Roberts, Enercon Services, Inc.
    Address 6525 N. Meridian, Suite 214
    Oklahoma City, OK 73116
    Phone Number (405) 722-7693

    Signature of Preparer:
    James Roberts Date 1/25/99

Attachments:
(a) Lab reports or records of external leak detection
(b) Site sketch



ISOTEK, L.L.C.
LABORATORY SERVICES
4901 West Reno, Suite 175, Oklahoma City, OK 73127-6320
(405) 948-8880 FAX: (405) 948-6015

RECEIVED 1-11-99

O.D.E.Q. Certification No. 9522

JANUARY 4, 1999

Laboratory Report No. 9805107

ENERCON SERVICES
6525 N. MERIDIAN, SUITE 214
OKLAHOMA CITY, OK 73116

PROJECT NAME:	OKLAHOMA BANK & TRUST
PROJECT LOCATION:	CLINTON, OK
PROJECT NO.:	ES116
SAMPLE I.D.:	CTP1
SAMPLE MATRIX:	SOIL
DATE SAMPLED:	DECEMBER 30, 1998
DATE RECEIVED:	DECEMBER 31, 1998
DATE ANALYZED:	JANUARY 4, 1999
TIME ANALYZED:	20:15 BY RANDY KITSMILLER

METHOD	REF	MDL	PARAMETER	SAMPLE RESULTS
8020	EPA	5 ug/kg	BENZENE	ND
8020	EPA	5 ug/kg	TOLUENE	ND
8020	EPA	5 ug/kg	ETHYLBENZENE	ND
8020	EPA	5 ug/kg	TOTAL XYLENES	ND
8020	EPA	-	SURROGATE (Trifluorotoluene) RECOVERY %	94.3 %
8015 M	ODEQ	1 mg/kg	Volatile TPH (Gasoline Range Organics)	ND
8000/8100	ODEQ	1 mg/kg	Extractable TPH (Diesel Range Organics)	ND

mg/kg	Milligrams per Kilogram, equivalent to parts per million.
ug/kg	Micrograms per Kilogram, equivalent to parts per billion.
ND	None Detected above stated detection limits.

Unless ISOTEK receives prior notification, all sample material not consumed in analysis will be retained for a period of 30 days before disposal.

Randy Kitsmiller
Certified By:

ISOTEK, L.L.C.

LABORATORY SERVICES

4901 West Reno, Suite 175, Oklahoma City, OK 73127-6320
(405) 948-8880 FAX: (405) 948-6015

O.D.E.Q. Certification No. 9522

JANUARY 4, 1999

Laboratory Report No. 9805108

ENERCON SERVICES
6525 N. MERIDIAN, SUITE 214
OKLAHOMA CITY, OK 73116

PROJECT NAME:	OKLAHOMA BANK & TRUST
PROJECT LOCATION:	CLINTON, OK
PROJECT NO.:	ES116
SAMPLE I.D.:	CTP2
SAMPLE MATRIX:	SOIL
DATE SAMPLED:	DECEMBER 30, 1998
DATE RECEIVED:	DECEMBER 31, 1998
DATE ANALYZED:	JANUARY 4, 1999
TIME ANALYZED:	20:52 BY RANDY KITSMILLER

METHOD	REF	MDL	PARAMETER	SAMPLE RESULTS
8020	EPA	5 ug/kg	BENZENE	ND
8020	EPA	5 ug/kg	TOLUENE	ND
8020	EPA	5 ug/kg	ETHYLBENZENE	ND
8020	EPA	5 ug/kg	TOTAL XYLENES	ND
8020	EPA	-	SURROGATE (Trifluorotoluene) RECOVERY %	100.6 %
8015 M	ODEQ	1 mg/kg	Volatile TPH (Gasoline Range Organics)	ND
8000/8100	ODEQ	1 mg/kg	Extractable TPH (Diesel Range Organics)	ND

mg/kg	Milligrams per Kilogram, equivalent to parts per million.
ug/kg	Micrograms per Kilogram, equivalent to parts per billion.
ND	None Detected above stated detection limits.

Unless ISOTEK receives prior notification, all sample material not consumed in analysis will be retained for a period of 30 days before disposal.

Randy Kitsmiller
Certified By:

ISOTEK, L.L.C.

LABORATORY SERVICES

4901 West Reno, Suite 175, Oklahoma City, OK 73127-6320
(405) 948-8880 FAX: (405) 948-6015

O.D.E.Q. Certification No. 9522

JANUARY 4, 1999

Laboratory Report No. 9805109

ENERCON SERVICES
6525 N. MERIDIAN, SUITE 214
OKLAHOMA CITY, OK 73116

PROJECT NAME:	OKLAHOMA BANK & TRUST
PROJECT LOCATION:	CLINTON, OK
PROJECT NO.:	ES116
SAMPLE I.D.:	CTP3
SAMPLE MATRIX:	SOIL
DATE SAMPLED:	DECEMBER 30, 1998
DATE RECEIVED:	DECEMBER 31, 1998
DATE ANALYZED:	JANUARY 4, 1999
TIME ANALYZED:	21:28 BY RANDY KITSMILLER

METHOD	REF	MDL	PARAMETER	SAMPLE RESULTS
8020	EPA	5 ug/kg	BENZENE	ND
8020	EPA	5 ug/kg	TOLUENE	ND
8020	EPA	5 ug/kg	ETHYLBENZENE	ND
8020	EPA	5 ug/kg	TOTAL XYLENES	ND
8020	EPA	-	SURROGATE (Trifluorotoluene) RECOVERY %	98.8 %
8015 M	ODEQ	1 mg/kg	Volatile TPH (Gasoline Range Organics)	ND
8000/8100	ODEQ	1 mg/kg	Extractable TPH (Diesel Range Organics)	ND

mg/kg	Milligrams per Kilogram, equivalent to parts per million.
ug/kg	Micrograms per Kilogram, equivalent to parts per billion.
ND	None Detected above stated detection limits.

Unless ISOTEK receives prior notification, all sample material not consumed in analysis will be retained for a period of 30 days before disposal.

Randy Kitsmiller

Certified By:

ISOTEK, L.L.C.

LABORATORY SERVICES

4901 West Reno, Suite 175, Oklahoma City, OK 73127-6320
(405) 948-8880 FAX: (405) 948-6015

O.D.E.Q. Certification No. 9522

JANUARY 4, 1999

Laboratory Report No. 9805110

ENERCON SERVICES
6525 N. MERIDIAN, SUITE 214
OKLAHOMA CITY, OK 73116

PROJECT NAME:	OKLAHOMA BANK & TRUST
PROJECT LOCATION:	CLINTON, OK
PROJECT NO.:	ES116
SAMPLE I.D.:	CTP4
SAMPLE MATRIX:	SOIL
DATE SAMPLED:	DECEMBER 30, 1998
DATE RECEIVED:	DECEMBER 31, 1998
DATE ANALYZED:	JANUARY 4, 1999
TIME ANALYZED:	22:05 BY RANDY KITSMILLER

METHOD	REF	MDL	PARAMETER	SAMPLE RESULTS
8020	EPA	5 ug/kg	BENZENE	ND
8020	EPA	5 ug/kg	TOLUENE	ND
8020	EPA	5 ug/kg	ETHYLBENZENE	ND
8020	EPA	5 ug/kg	TOTAL XYLENES	ND
8020	EPA	-	SURROGATE (Trifluorotolnene) RECOVERY %	98.9 %
8015 M	ODEQ	1 mg/kg	Volatile TPH (Gasoline Range Organics)	ND
8000/8100	ODEQ	1 mg/kg	Extractable TPH (Diesel Range Organics)	ND

mg/kg	Milligrams per Kilogram, equivalent to parts per million.
ug/kg	Micrograms per Kilogram, equivalent to parts per billion.
ND	None Detected above stated detection limits.

Unless ISOTEK receives prior notification, all sample material not consumed in analysis will be retained for a period of 30 days before disposal.

Certified By: Randy Kitsmiller

ANALYSIS REQUEST AND CHAIN OF CUSTODY RECORD

ENERCON SERVICES, INC.
6525 N. MERIDIAN, SUITE 214
OKLAHOMA CITY, OK 73116
(405) 722-7693
(405) 722-7694 FAX

REPORTING LABORATORY: ISOTEK
Date: 12-31-98
Name: ENERCON SERVICES, INC.
Address: 6525 N. MERIDIAN, SUITE 214
Contact: JIM ROBERTS Phone: 722-7693

Client/Project Name: OKLAHOMA BANK & TRUST
Project/Set Number: E5116
Project Location: CLINTON, OK

Sampler's Name (PRINT): JIM ROBERTS
Sampler's Affiliation:

PRIME LAB ID NO.	NO. & SIZE OF BOTT.	FIELD IDENTIFICATION/ SAMPLE NO.	DATE	TIME	SAMPLE TYPE (Liquid Sludge, etc)	BTEX (8020)	TPH-GRO (8015M)	TPH-DRO (8015M)	CONDITION ON RECEIPT
	1-40Z	CTP1	12/30/98	2:30pm	Soil	X	X	X	
	1-40Z	CTP2	12/30/98	3:30pm	Soil	X	X	X	
	1-40Z	CTP3	12/30/98	3:30pm	Soil	X	X	X	
	1-40Z	CTP4	12/30/98	3:50pm	Soil	X	X	X	

COC Seal Date:
CARRIER:
BILL NO.:

Relinquished by: (Sign) Date/Time: 12-31-98 1:55pm
Relinquished by: (Sign) Date/Time: 12-31-98 4:57

Received by: (Sign) Date/Time: 12-31-98 1:55pm
Received by: (Sign) Date/Time: 12/31/98 4:57

Data Results To: ENERCON SERVICES

January 12, 1999

James Roberts
Enercon Services Inc.
6525 North Meridian
Suite 214
Oklahoma City, OK 73116

RE: Disposal of Tanks

Dear Mr. Roberts:

I hauled off the following described tanks for use on my farms as culverts and scrap iron use. These tanks will not be used in any way for the storage of any petroleum products.

Neptune Drive and Industrial Road - Clinton, OK
1 - 20,000 gallon UST
2 - 12,000 gallon USTS

If you need any furthur information, please contact me.

Sincerely yours,

G. W. Lowry, Jr.

STATE OF OKLAHOMA, CUSTER COUNTY, SS:
The foregoing instrument was acknowledged before me this 12th day of January 1999 by G. W. Lowry, Jr.

My Commission Expires:
7-22-00

Rhonda G Boyd

Registration for Underground Storage Tanks

Oklahoma Corporation Commission
Underground Storage Tank Program
P.O. Box 52000-2000, Rm 250
Oklahoma City, OK 73152-2000

STATE USE ONLY

ID NUMBER

DATE RECEIVED

A. Date Entered Into Computer _____

B. Data Entry Clerk Initials _____

C. Owner was Contacted to Clarify Responses

Comments:

_____

_____

_____

_____

TYPE OF NOTIFICATION

☐ A. NEW FACILITY ☐ B. AMENDED

☒ C. CLOSURE

3 No. of tanks at facility ___ No. of continuation sheets attached.

INSTRUCTIONS

Please type or print in ink. This form must be completed for each location containing underground storage tanks. If more than four (4) tanks are owned at this location, photocopy the following sheets, and staple continuation sheets to the form.

General Information

Notification is required by Federal and State Law for all underground tanks that have been used to store regulated substances since January 1, 1974, that are in the ground as of May 8, 1985, or that are brought into use after May 8, 1986.

Penalties: Any owner who knowingly fails to notify or submits false information shall be subject to a civil penalty not to exceed $10,000 for each tank for which notification is not given or for which false information is submitted.

I. OWNERSHIP OF TANK(S)

Owner Name (Corporation, Individual, Public Agency, or Other Entity)

Oklahoma Bank & Trust Company

600 Gary Blvd. / P.O. Box 99
Street Address

Clinton, OK 73601
City & State Zip Code

(580) 323-2345
(Area Code) Phone Number

Date of Ownership Transfer _____

II. LOCATION OF TANK(S)

Facility Name or Company Site Identifier, as applicable

Unnamed

1401 Industrial Blvd.
Street Address (P.O. Box not acceptable)

Clinton, OK
City & State Zip Code

Custer

If known, give the geographic location of tanks by degrees, minutes, and seconds. Example: Lat. 42, 36, 12 N Long 85, 24, 17W.

Latitude _____ Longitude _____

III. TYPE OF OWNER	IV. INDIAN LANDS
☐ Federal Government ☐ Commercial ☐ State Government ☐ Farm ☐ Local Government ☒ Other Bank	Tanks are located on land within an Indian Reservation or on other trust lands. Tribe or Nation _____

V. CONTACT PERSON IN CHARGE OF TANKS

Name	Job Title	Address	Phone Number (Include Area Code)
G. W. Lowry	President	P.O. Box 99 Clinton, OK 73601	(580) 323-2345

VI. FINANCIAL RESPONSIBILITY

I have met the financial responsibility requirements in accordance with 40 CFR Subpart H. (Financial Responsibility must be met and acknowledged.) ☐

VII. DESCRIPTION OF UNDERGROUND STORAGE TANKS (COMPLETE FOR EACH TANK AT THIS LOCATION.

Tank Identification Number	Tank No. 1	Tank No. 2	Tank No. 3	Tank No.
1. Status of Tank (mark only one) Currently in Use	☐	☐	☐	☐
Temporarily Out of Use (Remember to fill out section VIII)	☐	☐	☐	☐
Permanently Out of Use (Remember to fill out section VIII)	X	X	X	☐
2. Date of Installation (mo./year)	Unknown	Unknown	Unknown	
3. Estimated Total Capacity (gallons)	20,000	12,000	12,000	
4. Material of Construction (Mark all that apply)				
Coated or Bare Steel	X	X	X	☐
Cathodically Protected Steel	☐	☐	☐	☐
Composite (Steel with Fiberglass)	☐	☐	☐	☐
Fiberglass Reinforced Plastic	☐	☐	☐	☐
Lined Interior	☐	☐	☐	☐
Double Walled	☐	☐	☐	☐
Polyethylene Tank Jacket	☐	☐	☐	☐
Concrete	☐	☐	☐	☐
Excavation Liner	☐	☐	☐	☐
Unknown	☐	☐	☐	☐
Other, Please specify	____	____	____	____
	____	____	____	____
	____	____	____	____

Tank Identification Number	Tank No. 1	Tank No. 2	Tank No. 3	Tank No ____
5. Piping (Material) (Mark all that appy) Steel	X	X	X	
Fiberglass Reinforced Plastic				
Copper				
Cathodically Protected				
Double Walled				
Secondary Containment				
Unknown				
Other, Please specify				
6. Piping (Mark all that apply) Pressure	X	X	X	
Suction: no valve at tank				
Suction: valve at tank				
7. Substances Currently or Last Stored in Greatest Quantity. Gasoline		X	X	
Diesel	X			
Gasohol				
Kerosene				
Heating Oil				
Used Oil				
Other, Please specify				
Hazardous Substance CAS Number or CERCLA Name				
VIII. TANKS OUT OF USE, OR CHANGE IN SERVICE				
1. Closing of Tank A. Estimated date last used	Unknown	Unknown	Unknown	
B. Estimate date tank closed or removed. (mo./date/year)	12/30/98	12/30/98	12/30/98	
C. Tank was removed from ground.	X	X	X	
D. Tank was closed in ground.				
E. Tank filled with inert material. Describe type of material used.				
F. Change in service.				
2. Site Assessment Completed	Yes	Yes	Yes	
Evidence of a leak detected	No	No	No	

REFERENCE 27

MEMORANDUM

June 29, 1990

TO: H. A. Caves, Chief
Consumer Protection Service

FROM: Paul H. Brown, Director PHB
Radiation Protection Division

SUBJECT: Radiation Survey of Sooner Dial

On April 24, 1990, Gary Ammon and I traveled to Clinton for the purpose of conducting a radiation survey of the building, land, and rubble which was associated with the Sooner Dial Facility. The present land owner, Ron Grubb, was contacted (405-323-6400), and we received his permission to survey the site. We were also assisted by our local sanitarian, Terry Thiesson.

Areas surveyed were the original site, which consists of a vacant lot and auto shop located at 1000-1004 10th Street, the adjacent alley, and surrounding property (see attached map). In addition, building rubble had been removed and transported to a dumping area approximately two (2) miles southeast of the site. This dump area is an isolated field in which fill material had been requested. No further development of this area is now planned.

A radiation survey was performed at all locations utilizing a Ludlum Micro-R meter. Gamma readings in excess of 50 micro-R per hour (approximately 7 to 8 times background) were noted and those areas delineated on the map. In addition, soil samples were taken for further analysis. Sample numbers and locations are also noted on the accompanying map.

Procedure for Analyzing Soil Samples

The radium-226 in soil samples were analyzed by Mark Kurklin of the radiochemistry laboratory in June 1990. They were first air dried and then crushed to a granular consistency. (They were not ground with a mortar and pestle.) Each sample was mixed well and a 25 gram aliquot of the soil was weighed into a plastic bottle that was used as the configuration for calibration. A known radium-226 standard was prepared using 25 grams of low background soil in the same plastic bottle configuration.

A gamma spectrum of each sample, the standard, and a blank was collected for 30 minutes on a Canberra Series 90 Multichannel Analyzer. The area under the radium-226, 186.1 KeV energy peak was determined using the gamma spectrum analysis computer software provided by Canberra Industries. The radioactivity due to radium-226 in each of the samples was calculated as proportional to the number of counts under the 186.1 KeV energy peak of the known standard. There was no apparent interference from uranium-235 which has a gamma peak at 185.7 KeV.

Regulatory Limits

Section 14, Table 3, Column 2 of the Oklahoma Radiation Protection Regulations indicates a release limit for insoluble Ra-226 in water as 3×10^{-5} microCuries/ml (30 pico Curie/ml). No specific table exists for soil contamination. However, it is an acceptable practice to convert this table to soil contamination limits by substituting the pCi/ml to pCi/gram. Therefore, the soil contamination limit should be 30 pCi/gram. (Further rationale to support this assumption can be obtained from Dale McHard).

The survey results and observations for each locale follow:

Dump Site

Again, this is a very isolated area containing numerous piles of building rubble. Gamma surveys were conducted, and three areas with elevated readings were staked, and soil samples collected. The results follow:

Area	Gamma Reading	Soil Depth	Activity/gram
1	350 Micro R/hr	0 - 6 In	385 pCi
2	250 Micro R/hr	0 - 6 In	18 pCi
3	200 Micro R/hr	0 - 6 In	226 pCi

This area does contain building rubble with residual radium in concentrations of concern. Due to its isolated location, at this time I would not recommend any removal. However, the area must be observed for any future development plans.

Auto Shop

Gamma surveys indicated three areas on the floor with measurable readings. However, these areas had been painted and marked. Swipe tests indicated no removal contamination. I consider the floor to be acceptable and no further remedial action is needed.

Vacant Lot

A building formerly located at the rear of the auto body shop had been removed in late 1984, and the rubble transported to the dump area previously mentioned. There appears to be concrete in areas of the lot 4 - 6 inches below the surface. The following sample locations (noted on the map) and readings are associated with this lot and the adjacent areas:

REFERENCE 28

EPA REGION 6- HUMAN HEALTH MEDIUM-SPECIFIC SCREENING LEVELS

Basis: C=carcinogenic effects
N=non-carcinogenic effects
sat= soil saturation concentration
max= maximum concentration

Contaminant	CAS No.	MCL or Action Level	Risk-Based Screening Levels						Soil Screening Level- Transfers from Soil to: Ground water (DAF=1)
			Soil (ingestion, inhalation, with and without dermal exposure routes)				Ambient Air (Residential Scenario)	Tap Water (Residential Scenario: Ingestion & Inhalation)	
			Residential	Residential w/o dermal	Industrial	Industrial w/o dermal			
		ug/l	mg/kg	mg/kg	mg/kg	mg/kg	ug/m3	ug/l	mg/kg
Acetaldehyde	75-07-0		9.3E+00 C	9.7E+00 C	2.1E+01 C	2.3E+01 C	8.7E-01 C	1.5E+00 C	
Acetochlor	34256-82-1		1.2E+03 N	1.6E+03 N	1.2E+04 N	4.1E+04 N	7.3E+01 N	7.3E+02 N	
Acetone	67-64-1		1.5E+03 N	1.6E+03 N	5.8E+03 N	6.2E+03 N	3.7E+02 N	6.1E+02 N	8.0E-01
Acetonitrile	75-05-8		6.2E+02 N	6.2E+02 N	2.0E+03 N	2.0E+03 N	6.2E+01 N		
Acetophenone	98-86-2		5.0E-01 N	5.0E-01 N	1.6E+00 N	1.6E+00 N	2.1E-02 N	4.2E-02 N	
Acrolein	107-02-8		1.0E-01 N	1.0E-01 N	3.4E-01 N	3.4E-01 N	2.1E-02 N	4.2E-02 N	
Acrylamide	79-06-1		1.1E-01 C	1.4E-01 C	3.8E-01 C	1.3E+00 C	1.5E-03 C	1.5E-02 C	
Acrylic acid	79-10-7		2.9E+04 N	3.7E+04 N	1.0E+05 max	1.0E+05 max	1.0E+00 N	1.8E+04 N	
Acrylonitrile	107-13-1		2.0E-01 C	2.1E-01 C	4.6E-01 C	5.2E-01 C	2.8E-02 C	3.9E-02 C	
Alachlor	15972-60-8	2.0E+00	6.0E+00 C	8.0E+00 C	2.2E+01 C	7.1E+01 C	8.4E-02 C	8.4E-01 C	
Alar	1596-84-5		9.1E+03 N	1.2E+04 N	9.3E+04 N	1.0E+05 max	5.5E+02 N	5.5E+03 N	
Aldicarb	116-06-3	7.0E+00	6.1E+01 N	7.8E+01 N	6.2E+02 N	2.0E+03 N	3.7E+00 N	3.7E+01 N	
Aldicarb sulfone	1646-88-4	7.0E+00	6.1E+01 N	7.8E+01 N	6.2E+02 N	2.0E+03 N	3.7E+00 N	3.7E+01 N	
Aldrin	309-00-2		2.8E-02 C	3.8E-02 C	1.0E-01 C	3.4E-01 C	3.9E-04 C	4.0E-03 C	5.9E+02
Allyl chloride	107-05-1		3.0E+03 N	3.9E+03 N	3.1E+04 N	9.7E+04 N	1.0E+00 N	1.8E+03 N	
Aluminum	7429-90-5		7.8E+04 N	7.8E+04 N	1.0E+05 max	1.0E+05 max		3.7E+04 N	
Amdro	67485-29-4		1.8E+01 N	2.3E+01 N	1.9E+02 N	6.1E+02 N	1.1E+00 N	1.1E+01 N	
4-Aminopyridine	504-24-5		1.2E+00 N	1.6E+00 N	1.2E+01 N	4.1E+01 N	7.3E-02 N	7.3E-01 N	
Ammonia	7664-41-7						1.0E+02 N		
Aniline	62-53-3		8.5E+01 C	1.1E+02 C	3.1E+02 C	1.0E+03 C	1.0E+00 N	1.2E+01 C	
Antimony and compounds	7440-36-0	6.0E+00	3.1E+01 N	3.1E+01 N	8.2E+02 N	8.2E+02 N		1.5E+01 N	3.0E-01
Antimony pentoxide	1314-60-9		3.9E+01 N	3.9E+01 N	1.0E+03 N	1.0E+03 N		1.8E+01 N	
Antimony tetroxide	1332-81-6		3.1E+01 N	3.1E+01 N	8.2E+02 N	8.2E+02 N		1.5E+01 N	
Antimony trioxide	1309-64-4		3.1E+01 N	3.1E+01 N	8.2E+02 N	8.2E+02 N		1.5E+01 N	
Arsenic (noncancer endpoint)	7440-38-2	5.0E+01	2.2E+01 N	2.3E+01 N	3.6E+02 N	6.1E+02 N			
Arsenic (cancer endpoint)	7440-38-2		3.9E-01 C	4.3E-01 C	2.3E+00 C	3.8E+00 C	4.5E-04 C	4.5E-02 C	1.0E+00

EPA REGION 6- HUMAN HEALTH MEDIUM-SPECIFIC SCREENING LEVELS

Basis: C=carcinogenic effects
N=non-carcinogenic effects
sat= soil saturation concentration
max= maximum concentration

Contaminant	CAS No.	MCL or Action Level	Risk-Based Screening Levels								Soil Screening Level- Transfers from Soil to: Ground water (DAF=1)	
			Soil (ingestion, inhalation, with and without dermal exposure routes)				Ambient Air (Residential Scenario)		Tap Water (Residential Scenario: Ingestion & Inhalation)			
			Residential		Residential w/o dermal		Industrial		Industrial w/o dermal			
		ug/l	mg/kg		mg/kg		mg/kg		mg/kg		ug/m3		ug/l		mg/kg
Arsine	7784-42-1										5.2E-02	N			
Assure	76578-12-6		5.5E+02	N	7.0E+02	N	5.6E+03	N	1.8E+04	N	3.3E+01	N	3.3E+02	N	
Atrazine	1912-24-9	3.0E+00	2.2E+00	C	2.9E+00	C	7.9E+00	C	2.6E+01	C	3.1E-02	C	3.0E-01	C	
Azobenzene	103-33-3		4.4E+00	C	5.8E+00	C	1.6E+01	C	5.2E+01	C	6.2E-02	C	6.1E-01	C	
Barium and compounds	7440-39-3	2.0E+03	5.4E+03	N	5.4E+03	N	1.0E+05	max	1.0E+05	max	5.2E-01	N	2.6E+03	N	8.2E+01
Baygon	114-26-1		2.4E+02	N	3.1E+02	N	2.5E+03	N	8.2E+03	N	1.5E+01	N	1.5E+02	N	
Baythroid	68359-37-5		1.5E+03	N	2.0E+03	N	1.6E+04	N	5.1E+04	N	9.1E+01	N	9.1E+02	N	
Bentazon	25057-89-0		1.8E+03	N	2.3E+03	N	1.9E+04	N	6.1E+04	N	1.1E+02	N	1.1E+03	N	
Benzaldehyde	100-52-7		6.1E+03	N	7.8E+03	N	6.2E+04	N	1.0E+05	max	3.7E+02	N	3.7E+03	N	
Benzene	71-43-2	5.0E+00	6.7E-01	C	6.8E-01	C	1.4E+00	C	1.5E+00	C	2.5E-01	C	4.2E-01	C	2.0E-03
Benzidine	92-87-5		2.1E-03	C	2.8E-03	C	7.6E-03	C	2.5E-02	C	2.9E-05	C	2.9E-04	C	
Benzoic acid	65-85-0		1.0E+05	max	1.0E+05	max	1.0E+05	max	1.0E+05	max	1.5E+04	N	1.5E+05	N	2.0E+01
Benzyl alcohol	100-51-6		1.8E+04	N	2.3E+04	N	1.0E+05	max	1.0E+05	max	1.1E+03	N	1.1E+04	N	
Benzyl chloride	100-44-7		8.3E-01	C	8.9E-01	C	2.0E+00	C	2.3E+00	C	4.0E-02	C	6.6E-02	C	
Beryllium and compounds	7440-41-7	4.0E+00	1.5E+02	N	1.5E+02	N	2.2E+03	C	2.2E+03	C	8.0E-04	C	7.3E+01	N	3.0E+00
1,1-Biphenyl	92-52-4		2.5E+03	N	3.0E+03	N	1.8E+04	N	3.0E+04	N	1.8E+02	N	3.0E+02	N	
Bis(2-chloroethyl)ether	111-44-4		1.9E-01	C	2.1E-01	C	4.9E-01	C	6.2E-01	C	5.8E-03	C	9.8E-03	C	2.0E-05
Bis(2-chloroisopropyl)ether	39638-32-9		2.6E+00	C	2.9E+00	C	6.6E+00	C	8.1E+00	C	1.9E-01	C	2.7E-01	C	
Bis(chloromethyl)ether	542-88-1		1.9E-04	C	1.9E-04	C	4.2E-04	C	4.4E-04	C	3.1E-05	C	5.2E-05	C	
Bis(2-ethylhexyl)phthalate (DEHP)	117-81-7	6.0E+00	3.5E+01	C	4.6E+01	C	1.2E+02	C	4.1E+02	C	4.8E-01	C	4.8E+00	C	
Boron	7440-42-8		5.5E+03	N	7.0E+03	N	5.6E+04	N	1.0E+05	max	2.1E+01	N	3.3E+03	N	
Boron trifluoride	7637-07-2		1.0E+05	max	1.0E+05	max	1.0E+05	max	1.0E+05	max	7.3E-01	N			
Bromobenzene	108-86-1		2.8E+01	N	2.8E+01	N	9.2E+01	N	9.3E+01	N	1.0E+01	N	2.0E+01	N	
Bromodichloromethane	75-27-4		9.9E-01	C	1.0E+00	C	2.2E+00	C	2.4E+00	C	1.1E-01	C	1.8E-01	C	3.0E-02
Bromoform	75-25-2		6.1E+01	C	8.1E+01	C	2.2E+02	C	7.2E+02	C	1.7E+00	C	8.5E+00	C	4.0E-02

EPA REGION 6- HUMAN HEALTH MEDIUM-SPECIFIC SCREENING LEVELS

Basis: C=carcinogenic effects
N=non-carcinogenic effects
sat= soil saturation concentration
max= maximum concentration

Contaminant	CAS No.	MCL or Action Level	Risk-Based Screening Levels						Soil Screening Level- Transfers from Soil to: Ground water (DAF=1)	
			Soil (ingestion, inhalation, with and without dermal exposure routes)				Ambient Air (Residential Scenario)	Tap Water (Residential Scenario: Ingestion & Inhalation)		
			Residential	Residential w/o dermal	Industrial	Industrial w/o dermal				
		ug/l	mg/kg	mg/kg	mg/kg	mg/kg	ug/m3	ug/l	mg/kg	
(tribromomethane)										
Bromomethane	74-83-9		3.9E+00 N	3.9E+00 N	1.3E+01 N	1.3E+01 N	5.2E+00 N	8.7E+00 N	1.0E-02	
Bromophos	2104-96-3		3.0E+02 N	3.9E+02 N	3.1E+03 N	1.0E+04 N	1.8E+01 N	1.8E+02 N		
Bromoxynil	1689-84-5		1.2E+03 N	1.6E+03 N	1.2E+04 N	4.1E+04 N	7.3E+01 N	7.3E+02 N		
1,3-Butadiene	106-99-0		6.5E-03 C	6.5E-03 C	1.4E-02 C	1.4E-02 C	6.9E-03 C	1.1E-02 C		
1-Butanol	71-36-3		6.1E+03 N	7.8E+03 N	6.2E+04 N	1.0E+05 max	3.7E+02 N	3.7E+03 N	9.0E-01	
Butylate	2008-41-5		3.0E+03 N	3.9E+03 N	3.1E+04 N	1.0E+05 max	1.8E+02 N	1.8E+03 N		
n-Butylbenzene	104-51-8		1.4E+02 N	1.4E+02 N	2.4E+02 sat	2.4E+02 sat	3.7E+01 N	6.1E+01 N		
sec-Butylbenzene	135-9-88		1.1E+02 N	1.1E+02 N	2.2E+02 sat	2.2E+02 sat	3.7E+01 N	6.1E+01 N		
tert-Butylbenzene	104-5-18		1.3E+02 N	1.3E+02 N	3.9E+02 sat	3.9E+02 sat	3.7E+01 N	6.1E+01 N		
Butyl benzyl phthalate	85-68-7		2.4E+02 sat	2.4E+02 sat	2.4E+02 sat	2.4E+02 sat	7.3E+02 N	7.3E+03 N	8.1E+02	
Cadmium and compounds	7440-43-9	5.0E+00	3.9E+01 N	3.9E+01 N	1.0E+03 N	1.0E+03 N	1.1E-03 C	1.8E+01 N	4.0E-01	
Caprolactam	105-60-2		3.0E+04 N	3.9E+04 N	1.0E+05 max	1.0E+05 max	1.8E+03 N	1.8E+04 N		
Captan	133-06-2		1.4E+02 C	1.8E+02 C	5.0E+02 C	1.6E+03 C	1.9E+00 C	1.9E+01 C		
Carbaryl	63-25-2		6.1E+03 N	7.8E+03 N	6.2E+04 N	1.0E+05 max	4.0E+02 N	3.7E+03 N		
Carbazole	86-74-8		2.4E+01 C	3.2E+01 C	8.7E+01 C	2.9E+02 C	3.4E-01 C	3.4E+00 C	3.0E-02	
Carbofuran	1563-66-2	4.0E+01	3.0E+02 N	3.9E+02 N	3.1E+03 N	1.0E+04 N	1.8E+01 N	1.8E+02 N		
Carbon disulfide	75-15-0		3.5E+02 N	3.6E+02 N	7.2E+02 sat	7.2E+02 sat	7.3E+02 N	1.0E+03 N	2.0E+00	
Carbon tetrachloride	56-23-5	5.0E+00	2.4E-01 C	2.4E-01 C	5.2E-01 C	5.3E-01 C	1.3E-01 C	1.7E-01 C	3.0E-03	
Carbosulfan	55285-14-8		6.1E+02 N	7.8E+02 N	6.2E+03 N	2.0E+04 N	3.7E+01 N	3.7E+02 N		
Chloral	302-17-0		1.2E+02 N	1.6E+02 N	1.2E+03 N	4.1E+03 N	7.3E+00 N	7.3E+01 N		
Chloranil	118-75-2		1.2E+00 C	1.6E+00 C	4.3E+00 C	1.4E+01 C	1.7E-02 C	1.7E-01 C		
Chlordane	57-74-9	2.0E+00	1.6E+00 C	1.8E+00 C	8.6E+00 C	1.6E+01 C	1.9E-02 C	1.9E-01 C	5.0E-01	
Chlorine	7782-50-5		7.8E+03 N	7.8E+03 N	1.0E+05 max	1.0E+05 max		3.7E+03 N		
Chlorine dioxide	10049-04-4						2.1E-01 N			
Chloroacetic acid	79-11-8		1.2E+02 N	1.6E+02 N	1.2E+03 N	4.1E+03 N	7.3E+00 N	7.3E+01 N		
4-Chloroaniline	106-47-8		2.4E+02 N	3.1E+02 N	2.5E+03 N	8.2E+03 N	1.5E+01 N	1.5E+02 N	3.0E-02	

EPA REGION 6- HUMAN HEALTH MEDIUM-SPECIFIC SCREENING LEVELS

Basis: C=carcinogenic effects
N=non-carcinogenic effects
sat= soil saturation concentration
max= maximum concentration

Contaminant	CAS No.	MCL or Action Level	Risk-Based Screening Levels						Soil Screening Level- Transfers from Soil to: Ground water (DAF=1)
			Soil (ingestion, inhalation, with and without dermal exposure routes)				Ambient Air (Residential Scenario)	Tap Water (Residential Scenario: Ingestion & Inhalation)	
			Residential	Residential w/o dermal	Industrial	Industrial w/o dermal			
		ug/l	mg/kg	mg/kg	mg/kg	mg/kg	ug/m3	ug/l	mg/kg
Chlorobenzene	108-90-7		5.4E+01 N	5.5E+01 N	1.8E+02 N	1.8E+02 N	2.1E+01 N	3.9E+01 N	7.0E-02
Chlorobenzilate	510-15-6		1.8E+00 C	2.4E+00 C	6.5E+00 C	2.1E+01 C	2.5E-02 C	2.5E-01 C	
p-Chlorobenzoic acid	74-11-3		1.2E+04 N	1.6E+04 N	1.0E+05 max	1.0E+05 max	7.3E+02 N	7.3E+03 N	
4-Chlorobenzotrifluoride	98-56-6		1.2E+03 N	1.6E+03 N	1.2E+04 N	4.1E+04 N	7.3E+01 N	7.3E+02 N	
2-Chloro-1,3-butadiene	126-99-8		3.6E+00 N	3.6E+00 N	1.2E+01 N	1.2E+01 N	7.3E+00 N	1.4E+01 N	
1-Chlorobutane	109-69-3		4.8E+02 sat	4.8E+02 sat	4.8E+02 sat	4.8E+02 sat	1.5E+03 N	2.4E+03 N	
1-Chloro-1,1-difluoroethane	75-68-3		3.4E+02 sat	3.4E+02 sat	3.4E+02 sat	3.4E+02 sat	5.2E+04 N	8.7E+04 N	
Chlorodifluoromethane	75-45-6		3.4E+02 sat	3.4E+02 sat	3.4E+02 sat	3.4E+02 sat	5.1E+04 N	8.5E+04 N	
2-Chloroethyl vinyl ether	110-75-8								
Chloroform	67-66-3		2.4E-01 C	2.4E-01 C	5.2E-01 C	5.2E-01 C	8.4E-02 C	1.6E-01 C	3.0E-02
Chloromethane	74-87-3		1.2E+00 C	1.2E+00 C	2.6E+00 C	2.7E+00 C	1.1E+00 C	1.5E+00 C	
4-Chloro-2-methylaniline	95-69-2		8.3E-01 C	1.1E+00 C	3.0E+00 C	9.9E+00 C	1.2E-02 C	1.2E-01 C	
beta-Chloronaphthalene	91-58-7		3.3E+03 N	3.9E+03 N	2.0E+04 N	2.7E+04 N	2.9E+02 N	4.9E+02 N	
o-Chloronitrobenzene	88-73-3		1.3E+01 C	1.5E+01 C	3.7E+01 C	5.9E+01 C	2.7E-01 C	4.5E-01 C	
p-Chloronitrobenzene	100-00-5		1.7E+01 C	2.0E+01 C	4.9E+01 C	7.6E+01 C	3.7E-01 C	6.2E-01 C	
2-Chlorophenol	95-57-8		6.1E+01 N	6.4E+01 N	2.3E+02 N	2.4E+02 N	1.8E+01 N	3.0E+01 N	2.0E-01
2-Chloropropane	75-29-6		1.7E+02 N	1.7E+02 N	5.8E+02 N	6.0E+02 N	1.0E+02 N	1.7E+02 N	
o-Chlorotoluene	95-49-8		1.5E+02 N	1.6E+02 N	5.1E+02 sat	5.1E+02 sat	7.3E+01 N	1.2E+02 N	
Chlorpyrifos	2921-88-2		1.8E+02 N	2.3E+02 N	1.9E+03 N	6.1E+03 N	1.1E+01 N	1.1E+02 N	
Chlorpyrifos-methyl	5598-13-0		6.1E+02 N	7.8E+02 N	6.2E+03 N	2.0E+04 N	3.7E+01 N	3.7E+02 N	
Chromium III	16065-83-1	1.0E+02	1.0E+05 max	1.0E+05 max	1.0E+05 max	1.0E+05 max		5.5E+04 N	
Total Chromium (1/6 ratio Cr VI/Cr III)	18540-29-9	1.0E+02	2.1E+02 C	2.1E+02 C	4.5E+02 C	4.5E+02 C	1.6E-04 C		2.0E+00
Chromium VI	7440-47-3	1.0E+02	3.0E+01 C	3.0E+01 C	6.4E+01 C	6.4E+01 C	2.3E-05 C	1.8E+02 N	2.0E+00
Cobalt	7440-48-4		3.4E+03 N	3.4E+03 N	2.9E+04 N	2.9E+04 N	2.1E-02 N	2.2E+03 N	
Coke Oven Emissions	8007-45-2			4.1E+03 C		8.7E+03 C	3.1E-03 C		

EPA REGION 6- HUMAN HEALTH MEDIUM-SPECIFIC SCREENING LEVELS

Basis: C=carcinogenic effects
N=non-carcinogenic effects
sat= soil saturation concentration
max= maximum concentration

Contaminant	CAS No.	MCL or Action Level	Risk-Based Screening Levels						Soil Screening Level- Transfers from Soil to: Ground water (DAF=1)
			Soil (ingestion, inhalation, with and without dermal exposure routes)				Ambient Air (Residential Scenario)	Tap Water (Residential Scenario: Ingestion & Inhalation)	
			Residential	Residential w/o dermal	Industrial	Industrial w/o dermal			
		ug/l	mg/kg	mg/kg	mg/kg	mg/kg	ug/m3	ug/l	mg/kg
Copper and compounds	7440-50-8	1.3E+03	2.9E+03 N	2.9E+03 N	7.6E+04 N	7.6E+04 N		1.4E+03 N	
Crotonaldehyde	123-73-9		5.3E-03 C	5.3E-03 C	1.1E-02 C	1.1E-02 C	3.5E-03 C	5.9E-03 C	
Cumene (isopropylbenzene)	98-82-8		1.6E+02 N	1.6E+02 N	5.2E+02 N	5.2E+02 N	4.0E+02 N	6.6E+02 N	
Cyanazine	21725-46-2		5.8E-01 C	7.6E-01 C	2.1E+00 C	6.8E+00 C	8.0E-03 C	8.0E-02 C	
Cyanides	n/a								
Barium cyanide	542-62-1		6.1E+03 N	7.8E+03 N	6.2E+04 N	1.0E+05 max		3.7E+03 N	
Calcium cyanide	592-01-8		2.4E+03 N	3.1E+03 N	2.5E+04 N	8.2E+04 N		1.5E+03 N	
Copper cyanide	544-92-3		3.0E+02 N	3.9E+02 N	3.1E+03 N	1.0E+04 N		1.8E+02 N	
Cyanogen	460-19-5		2.4E+03 N	3.1E+03 N	2.5E+04 N	8.2E+04 N			
Cyanogen bromide	506-68-3		5.5E+03 N	7.0E+03 N	5.6E+04 N	1.0E+05 max		3.3E+03 N	
Cyanogen chloride	506-77-4		3.0E+03 N	3.9E+03 N	3.1E+04 N	1.0E+05 max		1.8E+03 N	
Free cyanide	57-12-5	2.0E+02	1.2E+03 N	1.6E+03 N	1.2E+04 N	4.1E+04 N		7.3E+02 N	2.0E+00
Hydrogen cyanide	74-90-8		1.1E+01 N	1.1E+01 N	3.5E+01 N	3.5E+01 N	3.1E+00 N	6.2E+00 N	
Potassium cyanide	151-50-8		3.0E+03 N	3.9E+03 N	3.1E+04 N	1.0E+05 max		1.8E+03 N	
Potassium silver cyanide	506-61-6		1.2E+04 N	1.6E+04 N	1.0E+05 max	1.0E+05 max		7.3E+03 N	
Silver cyanide	506-64-9		6.1E+03 N	7.8E+03 N	6.2E+04 N	1.0E+05 max		3.7E+03 N	
Sodium cyanide	143-33-9		2.4E+03 N	3.1E+03 N	2.5E+04 N	8.2E+04 N		1.5E+03 N	
Zinc cyanide	557-21-1		3.0E+03 N	3.9E+03 N	3.1E+04 N	1.0E+05 max		1.8E+03 N	
Cyclohexanone	108-94-1		1.0E+05 max	1.0E+05 max	1.0E+05 max	1.0E+05 max	1.8E+04 N	1.8E+05 N	
Cyhalothrin/Karate	68085-85-8		3.0E+02 N	3.9E+02 N	3.1E+03 N	1.0E+04 N	1.8E+01 N	1.8E+02 N	
Cypermethrin	52315-07-8		6.1E+02 N	7.8E+02 N	6.2E+03 N	2.0E+04 N	3.7E+01 N	3.7E+02 N	
Dacthal	1861-32-1		6.1E+02 N	7.8E+02 N	6.2E+03 N	2.0E+04 N	3.7E+01 N	3.7E+02 N	
Dalapon	75-99-0	2.0E+02	1.8E+03 N	2.3E+03 N	1.9E+04 N	6.1E+04 N	1.1E+02 N	1.1E+03 N	
DDD	72-54-8		2.4E+00 C	2.7E+00 C	1.4E+01 C	2.4E+01 C	2.8E-02 C	2.8E-01 C	8.0E-01
DDE	72-55-9		1.7E+00 C	1.9E+00 C	1.0E+01 C	1.7E+01 C	2.0E-02 C	2.0E-01 C	3.0E+00
DDT	50-29-3		1.7E+00 C	1.9E+00 C	1.0E+01 C	1.7E+01 C	2.0E-02 C	2.0E-01 C	2.0E+00

EPA REGION 6- HUMAN HEALTH MEDIUM-SPECIFIC SCREENING LEVELS

Basis: C=carcinogenic effects
N=non-carcinogenic effects
sat= soil saturation concentration
max= maximum concentration

Contaminant	CAS No.	MCL or Action Level	Risk-Based Screening Levels								Soil Screening Level- Transfers from Soil to: Ground water (DAF=1)
			Soil (ingestion, inhalation, with and without dermal exposure routes)				Ambient Air (Residential Scenario)		Tap Water (Residential Scenario: Ingestion & Inhalation)		
			Residential	Residential w/o dermal	Industrial	Industrial w/o dermal					
		ug/l	mg/kg	mg/kg	mg/kg	mg/kg	ug/m3		ug/l		mg/kg
Diazinon	333-41-5		5.5E+01 N	7.0E+01 N	5.6E+02 N	1.8E+03 N	3.3E+00 N		3.3E+01 N		
Dibenzofuran	132-64-9		2.3E+02 N	2.9E+02 N	2.1E+03 N	5.1E+03 N	1.5E+01 N		2.4E+01 N		
1,4-Dibromobenzene	106-37-6		6.1E+02 N	7.8E+02 N	6.2E+03 N	2.0E+04 N	3.7E+01 N		3.7E+02 N		
Dibromochloromethane	124-48-1		9.7E-01 C	1.0E+00 C	2.2E+00 C	2.4E+00 C	8.0E-02 C		1.3E-01 C		2.0E-02
1,2-Dibromo-3-chloropropane	96-12-8		3.4E-01 C	4.5E-01 C	1.2E+00 C	4.0E+00 C	2.1E-01 N		4.8E-02 C		
1,2-Dibromoethane	106-93-4		5.3E-03 C	6.9E-03 C	1.8E-02 C	4.8E-02 C	8.7E-03 C		7.6E-04 C		
Dibutyl phthalate	84-74-2		6.1E+03 N	7.8E+03 N	6.2E+04 N	1.0E+05 max	3.7E+02 N		3.7E+03 N		2.7E+02
Dicamba	1918-00-9		1.8E+03 N	2.3E+03 N	1.9E+04 N	6.1E+04 N	1.1E+02 N		1.1E+03 N		
1,2-Dichlorobenzene	95-50-1		3.7E+02 sat	3.7E+02 sat	3.7E+02 sat	3.7E+02 sat	2.1E+02 N		3.7E+02 N		9.0E-01
1,3-Dichlorobenzene	541-73-1	6.0E+02	4.1E+01 N	4.1E+01 N	1.4E+02 N	1.4E+02 N	8.4E+00 N		1.7E+01 N		
1,4-Dichlorobenzene	106-46-7	7.5E+01	3.1E+00 C	3.2E+00 C	7.0E+00 C	7.5E+00 C	2.8E-01 C		4.7E-01 C		1.0E-01
3,3-Dichlorobenzidine	91-94-1		1.1E+00 C	1.4E+00 C	3.9E+00 C	1.3E+01 C	1.5E-02 C		1.5E-01 C		3.0E-04
1,4-Dichloro-2-butene	764-41-0		7.6E-03 C	7.9E-03 C	1.7E-02 C	1.8E-02 C	7.2E-04 C		1.2E-03 C		
Dichlorodifluoromethane	75-71-8		9.4E+01 N	9.4E+01 N	3.1E+02 N	3.1E+02 N	2.1E+02 N		3.9E+02 N		
1,1-Dichloroethane	75-34-3		5.8E+02 N	5.9E+02 N	2.0E+03 N	2.1E+03 N	5.2E+02 N		8.1E+02 N		1.0E+00
1,2-Dichloroethane (EDC)	107-06-2	5.0E+00	3.4E-01 C	3.5E-01 C	7.5E-01 C	7.7E-01 C	7.4E-02 C		1.2E-01 C		1.0E-03
1,1-Dichloroethylene	75-35-4	7.0E+00	5.3E-02 C	5.4E-02 C	1.2E-01 C	1.2E-01 C	3.8E-02 C		4.6E-02 C		3.0E-03
1,2-Dichloroethylene (cis)	156-59-2	7.0E+01	4.2E+01 N	4.3E+01 N	1.5E+02 N	1.5E+02 N	3.7E+01 N		6.1E+01 N		2.0E-02
1,2-Dichloroethylene (trans)	156-60-5	1.0E+02	6.3E+01 N	6.3E+01 N	2.1E+02 N	2.1E+02 N	7.3E+01 N		1.2E+02 N		3.0E-02
2,4-Dichlorophenol	120-83-2		1.8E+02 N	2.3E+02 N	1.9E+03 N	6.1E+03 N	1.1E+01 N		1.1E+02 N		5.0E-02
4-(2,4-Dichlorophenoxy)butyric Acid (2,4-DB)	94-82-6	7.0E+01	4.9E+02 N	6.3E+02 N	5.0E+03 N	1.6E+04 N	2.9E+01 N		2.9E+02 N		
2,4-Dichlorophenoxyacetic Acid (2,4-D)	94-75-7		6.8E+02 N	7.8E+02 N	9.6E+03 N	2.0E+04 N	3.7E+01 N		3.7E+02 N		

EPA REGION 6- HUMAN HEALTH MEDIUM-SPECIFIC SCREENING LEVELS

Basis: C=carcinogenic effects
N=non-carcinogenic effects
sat= soil saturation concentration
max= maximum concentration

Contaminant	CAS No.	MCL or Action Level	Risk-Based Screening Levels						Soil Screening Level- Transfers from Soil to: Ground water (DAF=1)
			Soil (ingestion, inhalation, with and without dermal exposure routes)				Ambient Air (Residential Scenario)	Tap Water (Residential Scenario: Ingestion & Inhalation)	
			Residential	Residential w/o dermal	Industrial	Industrial w/o dermal			
		ug/l	mg/kg	mg/kg	mg/kg	mg/kg	ug/m3	ug/l	mg/kg
1,2-Dichloropropane	78-87-5	5.0E+00	3.5E-01 C	3.5E-01 C	7.5E-01 C	7.7E-01 C	9.9E-02 C	1.6E-01 C	1.0E-03
1,3-Dichloropropene	542-75-6		8.2E-02 C	8.2E-02 C	1.8E-01 C	1.8E-01 C	5.2E-02 C	8.1E-02 C	2.0E-04
2,3-Dichloropropanol	616-23-9		1.8E+02 N	2.3E+02 N	1.9E+03 N	6.1E+03 N	1.1E+01 N	1.1E+02 N	
Dichlorvos	62-73-7		1.7E+00 C	2.2E+00 C	6.0E+00 C	2.0E+01 C	2.3E-02 C	2.3E-01 C	
Dicofol	115-32-2		1.1E+00 C	1.5E+00 C	4.0E+00 C	1.3E+01 C	1.5E-02 C	1.5E-01 C	
Dicyclopentadiene	77-73-6		5.5E-01 N	5.5E-01 N	1.8E+00 N	1.8E+00 N	2.1E-01 N	4.2E-01 N	
Dieldrin	60-57-1		3.0E-02 C	4.0E-02 C	1.1E-01 C	3.6E-01 C	4.2E-04 C	4.2E-03 C	2.0E-04
Diethylene glycol, monobutyl ether	112-34-5		3.5E+02 N	4.5E+02 N	3.6E+03 N	1.2E+04 N	2.1E+01 N	2.1E+02 N	
Diethylene glycol, monoethyl ether	111-90-0		1.0E+05 max	1.0E+05 max	1.0E+05 max	1.0E+05 max	7.3E+03 N	7.3E+04 N	
Di(2-ethylhexyl)adipate	103-23-1	4.0E+02	4.0E+02 C	5.3E+02 C	1.5E+03 C	4.8E+03 C	5.6E+00 C	5.6E+01 C	
Diethyl phthalate	84-66-2		4.9E+04 N	6.3E+04 N	1.0E+05 max	1.0E+05 max	2.9E+03 N	2.9E+04 N	
Diethylstilbestrol	56-53-1		1.0E-04 C	1.4E-04 C	3.7E-04 C	1.2E-03 C	1.4E-06 C	1.4E-05 C	
Difenzoquat (Avenge)	43222-48-6		4.9E+03 N	6.3E+03 N	5.0E+04 N	1.0E+05 max	2.9E+02 N	2.9E+03 N	
1,1-Difluoroethane	75-37-6		1.0E+05 max	1.0E+05 max	1.0E+05 max	1.0E+05 max	4.2E+04 N	6.9E+04 N	
Diisopropyl methylphosphonate	1445-75-6		4.9E+03 N	6.3E+03 N	5.0E+04 N	1.0E+05 max	2.9E+02 N	2.9E+03 N	
3,3'-Dimethoxybenzidine	119-90-4		3.5E+01 C	4.6E+01 C	1.2E+02 C	4.1E+02 C	4.8E-01 C	4.8E+00 C	
Dimethylamine	124-40-3		6.4E-02 N	6.7E-02 N	2.4E-01 N	2.5E-01 N	2.1E-02 N	3.5E-02 N	
N-N-Dimethylaniline	121-69-7		1.2E+02 N	1.6E+02 N	1.2E+03 N	4.1E+03 N	7.3E+00 N	7.3E+01 N	
2,4-Dimethylaniline	95-68-1		6.4E-01 C	8.5E-01 C	2.3E+00 C	7.6E+00 C	9.0E-03 C	9.0E-02 C	
2,4-Dimethylaniline hydrochloride	21436-96-4		8.3E-01 C	1.1E+00 C	3.0E+00 C	9.9E+00 C	1.2E-02 C	1.2E-01 C	
3,3'-Dimethylbenzidine	119-93-7		5.3E-02 C	7.0E-02 C	1.9E-01 C	6.2E-01 C	7.3E-04 C	7.3E-03 C	
1,1-Dimethylhydrazine	57-14-7		1.9E-01 C	2.5E-01 C	6.7E-01 C	2.2E+00 C	1.9E-03 C	2.6E-02 C	
1,2-Dimethylhydrazine	540-73-8		1.3E-02 C	1.7E-02 C	4.7E-02 C	1.5E-01 C	1.8E-04 C	1.8E-03 C	

EPA REGION 6- HUMAN HEALTH MEDIUM-SPECIFIC SCREENING LEVELS

Basis: C=carcinogenic effects
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sat= soil saturation concentration
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Contaminant	CAS No.	MCL or Action Level	Risk-Based Screening Levels						Soil Screening Level- Transfers from Soil to: Ground water (DAF=1)
			Soil (ingestion, inhalation, with and without dermal exposure routes)				Ambient Air (Residential Scenario)	Tap Water (Residential Scenario: Ingestion & Inhalation)	
			Residential	Residential w/o dermal	Industrial	Industrial w/o dermal			
		ug/l	mg/kg	mg/kg	mg/kg	mg/kg	ug/m3	ug/l	mg/kg
Dimethylphenethylamine	122-09-8		6.1E+01 N	7.8E+01 N	6.2E+02 N	2.0E+03 N	3.7E+00 N	3.7E+01 N	
2,4-Dimethylphenol	105-67-9		1.2E+03 N	1.6E+03 N	1.2E+04 N	4.1E+04 N	7.3E+01 N	7.3E+02 N	4.0E-01
2,6-Dimethylphenol	576-26-1		3.6E+01 N	4.7E+01 N	3.7E+02 N	1.2E+03 N	2.2E+00 N	2.2E+01 N	
3,4-Dimethylphenol	95-65-8		6.1E+01 N	7.8E+01 N	6.2E+02 N	2.0E+03 N	3.7E+00 N	3.7E+01 N	
Dimethyl phthalate	131-11-3		1.0E+05 max	1.0E+05 max	1.0E+05 max	1.0E+05 max	3.7E+04 N	3.7E+05 N	
4,6-Dinitro-o-cyclohexyl phenol	131-89-5		1.2E+02 N	1.6E+02 N	1.2E+03 N	4.1E+03 N	7.3E+00 N	7.3E+01 N	
1,2-Dinitrobenzene	528-29-0		2.4E+01 N	3.1E+01 N	2.5E+02 N	8.2E+02 N	1.5E+00 N	1.5E+01 N	
1,3-Dinitrobenzene	99-65-0		6.1E+00 N	7.8E+00 N	6.2E+01 N	2.0E+02 N	3.7E-01 N	3.7E+00 N	
1,4-Dinitrobenzene	100-25-4		2.4E+01 N	3.1E+01 N	2.5E+02 N	8.2E+02 N	1.5E+00 N	1.5E+01 N	
2,4-Dinitrophenol	51-28-5		1.2E+02 N	1.6E+02 N	1.2E+03 N	4.1E+03 N	7.3E+00 N	7.3E+01 N	1.0E-02
Dinitrotoluene mixture	25321-14-6		7.1E-01 C	9.4E-01 C	2.6E+00 C	8.4E+00 C	9.9E-03 C	9.9E-02 C	4.0E-05
2,4-Dinitrotoluene	121-14-2		1.2E+02 N	1.6E+02 N	1.2E+03 N	4.1E+03 N	7.3E+00 N	7.3E+01 N	4.0E-05
2,6-Dinitrotoluene	606-20-2		6.1E+01 N	7.8E+01 N	6.2E+02 N	2.0E+03 N	3.7E+00 N	3.7E+01 N	3.0E-05
Dinoseb	88-85-7	7.0E+00	6.1E+01 N	7.8E+01 N	6.2E+02 N	2.0E+03 N	3.7E+00 N	3.7E+01 N	
di-n-Octyl phthalate	117-84-0		1.2E+03 N	1.6E+03 N	1.2E+04 N	4.1E+04 N	7.3E+01 N	7.3E+02 N	1.0E+04
1,4-Dioxane	123-91-1		4.4E+01 C	5.8E+01 C	1.6E+02 C	5.2E+02 C	6.1E-01 C	6.1E+00 C	
Dioxin (2,3,7,8-TCDD)	1746-01-6		3.9E-06 C	4.3E-06 C	2.3E-05 C	3.8E-05 C	4.5E-08 C	4.5E-07 C	
Diphenylamine	122-39-4		1.5E+03 N	2.0E+03 N	1.6E+04 N	5.1E+04 N	9.1E+01 N	9.1E+02 N	
1,2-Diphenylhydrazine	122-66-7		6.0E-01 C	8.0E-01 C	2.2E+00 C	7.2E+00 C	8.7E-03 C	8.4E-02 C	
Diphenyl sulfone	127-63-9		5.5E+02 N	7.0E+02 N	5.6E+03 N	1.8E+04 N	3.3E+01 N	3.3E+02 N	
Diquat	85-00-7	2.0E+01	1.3E+02 N	1.7E+02 N	1.4E+03 N	4.5E+03 N	8.0E+00 N	8.0E+01 N	
Disulfoton	298-04-4		2.4E+00 N	3.1E+00 N	2.5E+01 N	8.2E+01 N	1.5E-01 N	1.5E+00 N	
1,4-Dithiane	505-29-3		6.1E+02 N	7.8E+02 N	6.2E+03 N	2.0E+04 N	3.7E+01 N	3.7E+02 N	
Diuron	330-54-1		1.2E+02 N	1.6E+02 N	1.2E+03 N	4.1E+03 N	7.3E+00 N	7.3E+01 N	
Endosulfan	115-29-7		3.6E+02 N	4.7E+02 N	3.7E+03 N	1.2E+04 N	2.2E+01 N	2.2E+02 N	9.0E-01
Endothall	145-73-3	1.0E+02	1.2E+03 N	1.6E+03 N	1.2E+04 N	4.1E+04 N	7.3E+01 N	7.3E+02 N	

EPA REGION 6- HUMAN HEALTH MEDIUM-SPECIFIC SCREENING LEVELS

Basis: C=carcinogenic effects
N=non-carcinogenic effects
sat= soil saturation concentration
max= maximum concentration

Contaminant	CAS No.	MCL or Action Level	Risk-Based Screening Levels						Soil Screening Level- Transfers from Soil to: Ground water (DAF=1)
			Soil (ingestion, inhalation, with and without dermal exposure routes)				Ambient Air (Residential Scenario)	Tap Water (Residential Scenario: Ingestion & Inhalation)	
			Residential	Residential w/o dermal	Industrial	Industrial w/o dermal			
		ug/l	mg/kg	mg/kg	mg/kg	mg/kg	ug/m3	ug/l	mg/kg
Endrin	72-20-8	2.0E+00	1.8E+01 N	2.3E+01 N	1.9E+02 N	6.1E+02 N	1.1E+00 N	1.1E+01 N	5.0E-02
Epichlorohydrin	106-89-8		7.5E+00 N	7.6E+00 N	2.5E+01 N	2.6E+01 N	1.0E+00 N	2.0E+00 N	
Ethion	563-12-2		3.0E+01 N	3.9E+01 N	3.1E+02 N	1.0E+03 N	1.8E+00 N	1.8E+01 N	
2-Ethoxyethanol	110-80-5		2.4E+04 N	3.1E+04 N	1.0E+05 max	1.0E+05 max	2.1E+02 N	1.5E+04 N	
2-Ethoxyethanol acetate	111-15-9		1.8E+04 N	2.3E+04 N	1.0E+05 max	1.0E+05 max	1.1E+03 N	1.1E+04 N	
Ethyl acetate	141-78-6		1.7E+04 N	1.9E+04 N	3.7E+04 sat	3.7E+04 sat	3.3E+03 N	5.5E+03 N	
Ethylbenzene	100-41-4	7.0E+02	2.3E+02 sat	2.3E+02 sat	2.3E+02 sat	2.3E+02 sat	1.1E+03 N	1.3E+03 N	7.0E-01
Ethyl chloride	75-00-3		1.6E+03 sat	1.6E+03 sat	1.6E+03 sat	1.6E+03 sat	1.0E+04 N	8.6E+03 N	
Ethylene diamine	107-15-3		1.2E+03 N	1.6E+03 N	1.2E+04 N	4.1E+04 N	7.3E+01 N	7.3E+02 N	
Ethylene glycol	107-21-1		1.0E+05 max	1.0E+05 max	1.0E+05 max	1.0E+05 max	7.3E+03 N	7.3E+04 N	
Ethylene glycol, monobutyl ether	111-76-2		3.5E+02 N	4.5E+02 N	3.6E+03 N	1.2E+04 N	2.1E+01 N	2.1E+02 N	
Ethylene oxide	75-21-8		1.3E-01 C	1.4E-01 C	3.1E-01 C	3.6E-01 C	1.9E-02 C	2.4E-02 C	
Ethylene thiourea (ETU)	96-45-7		4.4E+00 C	5.8E+00 C	1.6E+01 C	5.2E+01 C	6.1E-02 C	6.1E-01 C	
Ethyl ether	60-29-7		1.8E+03 sat	1.8E+03 sat	1.8E+03 sat	1.8E+03 sat	7.3E+02 N	1.2E+03 N	
Ethyl methacrylate	97-63-2		1.4E+02 sat	1.4E+02 sat	1.4E+02 sat	1.4E+02 sat	3.3E+02 N	5.5E+02 N	
Fenamiphos	22224-92-6		1.5E+01 N	2.0E+01 N	1.6E+02 N	5.1E+02 N	9.1E-01 N	9.1E+00 N	
Fluometuron	2164-17-2		7.9E+02 N	1.0E+03 N	8.1E+03 N	2.7E+04 N	4.7E+01 N	4.7E+02 N	
Fluoride	16984-48-8		3.6E+03 N	4.7E+03 N	3.7E+04 N	1.0E+05 max		2.2E+03 N	
Fomesafen	72178-02-0		2.5E+00 C	3.4E+00 C	9.2E+00 C	3.0E+01 C	3.5E-02 C	3.5E-01 C	
Fonofos	944-22-9		1.2E+02 N	1.6E+02 N	1.2E+03 N	4.1E+03 N	7.3E+00 N	7.3E+01 N	
Formaldehyde	50-00-0		9.1E+03 N	1.2E+04 N	9.3E+04 N	1.0E+05 max	1.5E-01 C	5.5E+03 N	
Formic Acid	64-18-6		1.0E+05 max	1.0E+05 max	1.0E+05 max	1.0E+05 max	7.3E+03 N	7.3E+04 N	
Furan	110-00-9		2.5E+00 N	2.5E+00 N	8.5E+00 N	8.6E+00 N	3.7E+00 N	6.1E+00 N	
Furazolidone	67-45-8		1.3E-01 C	1.7E-01 C	4.6E-01 C	1.5E+00 C	1.8E-03 C	1.8E-02 C	
Furfural	98-01-1		1.8E+02 N	2.3E+02 N	1.9E+03 N	6.1E+03 N	5.2E+01 N	1.1E+02 N	
Glycidaldehyde	765-34-4		2.4E+01 N	3.1E+01 N	2.5E+02 N	8.2E+02 N	1.0E+00 N	1.5E+01 N	

EPA REGION 6- HUMAN HEALTH MEDIUM-SPECIFIC SCREENING LEVELS

Basis: C=carcinogenic effects
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sat= soil saturation concentration
max= maximum concentration

Contaminant	CAS No.	MCL or Action Level	Risk-Based Screening Levels						Soil Screening Level- Transfers from Soil to: Ground water (DAF=1)
			Soil (ingestion, inhalation, with and without dermal exposure routes)				Ambient Air (Residential Scenario)	Tap Water (Residential Scenario: Ingestion & Inhalation)	
			Residential	Residential w/o dermal	Industrial	Industrial w/o dermal			
		ug/l	mg/kg	mg/kg	mg/kg	mg/kg	ug/m3	ug/l	mg/kg
Glyphosate	1071-83-6	7.0E+02	6.1E+03 N	7.8E+03 N	6.2E+04 N	1.0E+05 max	3.7E+02 N	3.7E+03 N	
Heptachlor	76-44-8	1.0E-01	1.1E-01 C	1.4E-01 C	3.9E-01 C	1.3E+00 C	1.5E-03 C	1.5E-02 C	1.0E+00
Heptachlor epoxide	1024-57-3	2.0E-01	5.3E-02 C	7.0E-02 C	1.9E-01 C	6.3E-01 C	7.4E-04 C	7.4E-03 C	3.0E-02
Hexabromobenzene	87-82-1		1.2E+02 N	1.6E+02 N	1.2E+03 N	4.1E+03 N	7.3E+00 N	7.3E+01 N	
Hexachlorobenzene	118-74-1	1.0E+00	3.0E-01 C	4.0E-01 C	1.1E+00 C	3.6E+00 C	4.2E-03 C	4.2E-02 C	1.0E-01
Hexachlorobutadiene	87-68-3		6.2E+00 C	8.2E+00 C	2.2E+01 C	7.3E+01 C	8.7E-02 C	8.6E-01 C	1.0E-01
HCH (alpha)	319-84-6		9.0E-02 C	1.0E-01 C	4.8E-01 C	9.1E-01 C	1.1E-03 C	1.1E-02 C	3.0E-05
HCH (beta)	319-85-7		3.1E-01 C	3.6E-01 C	1.7E+00 C	3.2E+00 C	3.7E-03 C	3.7E-02 C	1.0E-04
HCH (gamma) Lindane	58-89-9	2.0E-01	4.4E-01 C	4.9E-01 C	2.3E+00 C	4.4E+00 C	5.2E-03 C	5.2E-02 C	5.0E-04
HCH-technical	608-73-1		3.1E-01 C	3.6E-01 C	1.7E+00 C	3.2E+00 C	3.8E-03 C	3.7E-02 C	1.0E-04
Hexachlorocyclo-pentadiene	77-47-4	5.0E+01	4.2E+02 N	5.4E+02 N	4.2E+03 N	1.3E+04 N	7.3E-02 N	2.6E+02 N	2.0E+01
Hexachlorodibenzo-p-dioxin mixture (HxCDD)	19408-74-3		7.8E-05 C	1.0E-04 C	2.8E-04 C	9.2E-04 C	1.5E-06 C	1.1E-05 C	
Hexachloroethane	67-72-1		3.5E+01 C	4.6E+01 C	1.2E+02 C	4.1E+02 C	4.8E-01 C	4.8E+00 C	2.0E-02
Hexachlorophene	70-30-4		1.8E+01 N	2.3E+01 N	1.9E+02 N	6.1E+02 N	1.1E+00 N	1.1E+01 N	
Hexahydro-1,3,5-trinitro-1,3,5-triazine	121-82-4		4.4E+00 C	5.8E+00 C	1.6E+01 C	5.2E+01 C	6.1E-02 C	6.1E-01 C	
1,6-Hexamethylene diisocyanate	822-06-0		1.7E-01 N	2.2E-01 N	1.8E+00 N	5.8E+00 N	1.0E-02 N	1.0E-01 N	
n-Hexane	110-54-3		1.1E+02 sat	1.1E+02 sat	1.1E+02 sat	1.1E+02 sat	2.1E+02 N	3.5E+02 N	
Hexazinone	51235-04-2		2.0E+03 N	2.6E+03 N	2.1E+04 N	6.7E+04 N	1.2E+02 N	1.2E+03 N	
Hydrazine, hydrazine sulfate	302-01-2		1.6E-01 C	2.1E-01 C	5.8E-01 C	1.9E+00 C	3.9E-04 C	2.2E-02 C	
Hydrogen chloride	7647-01-0		1.0E+05 max	1.0E+05 max	1.0E+05 max	1.0E+05 max	2.1E+01 N		
Hydrogen sulfide	7783-06-4		1.8E+02 N	2.3E+02 N	1.9E+03 N	6.1E+03 N	1.0E+00 N	1.1E+02 N	
p-Hydroquinone	123-31-9		2.4E+03 N	3.1E+03 N	2.5E+04 N	8.2E+04 N	1.5E+02 N	1.5E+03 N	

EPA REGION 6- HUMAN HEALTH MEDIUM-SPECIFIC SCREENING LEVELS

Basis: C=carcinogenic effects
N=non-carcinogenic effects
sat= soil saturation concentration
max= maximum concentration

Contaminant	CAS No.	MCL or Action Level	Risk-Based Screening Levels								Soil Screening Level- Transfers from Soil to: Ground water (DAF=1)
			Soil (ingestion, inhalation, with and without dermal exposure routes)				Ambient Air (Residential Scenario)	Tap Water (Residential Scenario: Ingestion & Inhalation)			
			Residential	Residential w/o dermal	Industrial	Industrial w/o dermal					
		ug/l	mg/kg	mg/kg	mg/kg	mg/kg	ug/m3	ug/l			mg/kg
Iron	7439-89-6		2.3E+04	N	2.3E+04	N	1.0E+05	max	1.0E+05	max			1.1E+04	N	
Isobutanol	78-83-1		1.1E+04	N	1.3E+04	N	4.0E+04	sat	4.0E+04	sat	1.1E+03	N	1.8E+03	N	
Isophorone	78-59-1		5.1E+02	C	6.7E+02	C	1.8E+03	C	6.0E+03	C	7.1E+00	C	7.1E+01	C	3.0E-02
Isopropalin	33820-53-0		9.1E+02	N	1.2E+03	N	9.3E+03	N	3.1E+04	N	5.5E+01	N	5.5E+02	N	
Isopropyl methyl phosphonic acid	1832-54-8		6.1E+03	N	7.8E+03	N	6.2E+04	N	1.0E+05	max	4.0E+02	N	3.7E+03	N	
Kepone	143-50-0		2.7E-02	C	3.6E-02	C	9.7E-02	C	3.2E-01	C	3.7E-04	C	3.7E-03	C	
Lead	7439-92-1	1.5E+01	4.0E+02				2.0E+03						1.5E+01		
Lead (tetraethyl)	78-00-2		6.1E-03	N	7.8E-03	N	6.2E-02	N	2.0E-01	N			3.7E-03	N	
Lithium	7439-93-2		1.6E+03	N	1.6E+03	N	4.1E+04	N	4.1E+04	N			7.3E+02	N	
Malathion	121-75-5		1.2E+03	N	1.6E+03	N	1.2E+04	N	4.1E+04	N	7.3E+01	N	7.3E+02	N	
Maleic anhydride	108-31-6		6.1E+03	N	7.8E+03	N	6.2E+04	N	1.0E+05	max	3.7E+02	N	3.7E+03	N	
Manganese and compounds	7439-96-5		3.2E+03	N	3.2E+03	N	4.7E+04	N	4.7E+04	N	5.1E-02	N	1.7E+03	N	
Mephosfolan	950-10-7		5.5E+00	N	7.0E+00	N	5.6E+01	N	1.8E+02	N	3.3E-01	N	3.3E+00	N	
Mepiquat	24307-26-4		1.8E+03	N	2.3E+03	N	1.9E+04	N	6.1E+04	N	1.1E+02	N	1.1E+03	N	
2-Mercaptobenzothiazole	149-30-4		1.7E+01	C	2.2E+01	C	6.0E+01	C	2.0E+02	C	2.3E-01	C	2.3E+00	C	
Mercury and compounds	7487-94-7	2.0E+00	2.3E+01	N	2.3E+01	N	6.1E+02	N	6.1E+02	N			1.1E+01	N	
Mercury (elemental)	7439-97-6										3.1E-01	N			
Mercury (methyl)	22967-92-6		6.1E+00	N	7.8E+00	N	6.2E+01	N	2.0E+02	N			3.7E+00	N	
Methacrylonitrile	126-98-7		1.9E+00	N	2.1E+00	N	8.0E+00	N	8.8E+00	N	7.3E-01	N	1.0E+00	N	
Methanol	67-56-1		3.0E+04	N	3.9E+04	N	1.0E+05	max	1.0E+05	max	1.8E+03	N	1.8E+04	N	
Methidathion	950-37-8		6.1E+01	N	7.8E+01	N	6.2E+02	N	2.0E+03	N	3.7E+00	N	3.7E+01	N	
Methoxychlor	72-43-5	4.0E+01	3.0E+02	N	3.9E+02	N	3.1E+03	N	1.0E+04	N	1.8E+01	N	1.8E+02	N	8.0E+00
Methyl acetate	79-20-9		2.0E+04	N	2.2E+04	N	8.7E+04	N	9.6E+04	N	3.7E+03	N	6.1E+03	N	
Methyl acrylate	96-33-3		6.9E+01	N	7.0E+01	N	2.3E+02	N	2.3E+02	N	1.1E+02	N	1.8E+02	N	
2-Methylaniline (o-	95-53-4		2.0E+00	C	2.7E+00	C	7.3E+00	C	2.4E+01	C	2.8E-02	C	2.8E-01	C	

EPA REGION 6- HUMAN HEALTH MEDIUM-SPECIFIC SCREENING LEVELS

Basis: C=carcinogenic effects
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sat= soil saturation concentration
max= maximum concentration

Contaminant	CAS No.	MCL or Action Level	Risk-Based Screening Levels						Soil Screening Level- Transfers from Soil to: Ground water (DAF=1)
			Soil (ingestion, inhalation, with and without dermal exposure routes)				Ambient Air (Residential Scenario)	Tap Water (Residential Scenario: Ingestion & Inhalation)	
			Residential	Residential w/o dermal	Industrial	Industrial w/o dermal			
		ug/l	mg/kg	mg/kg	mg/kg	mg/kg	ug/m3	ug/l	mg/kg
toluidine)									
2-Methyl-4-chlorophenoxyacetic acid	94-74-6		3.0E+01 N	3.9E+01 N	3.1E+02 N	1.0E+03 N	1.8E+00 N	1.8E+01 N	
4-(2-Methyl-4-chlorophenoxy) butyric acid (MCPB)	94-81-5		6.1E+02 N	7.8E+02 N	6.2E+03 N	2.0E+04 N	3.7E+01 N	3.7E+02 N	
2-(2-Methyl-4-chlorophenoxy) propionic acid	93-65-2		6.1E+01 N	7.8E+01 N	6.2E+02 N	2.0E+03 N	3.7E+00 N	3.7E+01 N	
2-(2-Methyl-1,4-chlorophenoxy) propionic acid (MCPP)	16484-77-8		6.1E+01 N	7.8E+01 N	6.2E+02 N	2.0E+03 N	3.7E+00 N	3.7E+01 N	
Methylcyclohexane	108-87-2		1.4E+02 sat	1.4E+02 sat	1.4E+02 sat	1.4E+02 sat	3.1E+03 N	5.2E+03 N	
4,4'-Methylene bis(2-chloroaniline)	101-14-4		3.7E+00 C	4.9E+00 C	1.3E+01 C	4.4E+01 C	5.2E-02 C	5.2E-01 C	
4,4'-Methylene bis(N,N'-dimethyl)aniline	101-61-1		1.1E+01 C	1.4E+01 C	3.8E+01 C	1.2E+02 C	1.5E-01 C	1.5E+00 C	
Methylene bromide	74-95-3		1.3E+02 N	1.4E+02 N	5.2E+02 N	5.5E+02 N	3.7E+01 N	6.1E+01 N	
Methylene chloride	75-09-2		8.6E+00 C	8.9E+00 C	1.9E+01 C	2.1E+01 C	4.1E+00 C	4.3E+00 C	1.0E-03
4,4'-Methylenediphenyl isocyanate	101-68-8		1.0E+01 N	1.3E+01 N	1.1E+02 N	3.5E+02 N	6.2E-01 N	6.2E+00 N	
Methyl ethyl ketone	78-93-3		7.0E+03 N	7.3E+03 N	2.6E+04 N	2.8E+04 N	1.0E+03 N	1.9E+03 N	
Methyl hydrazine	60-34-4		4.4E-01 C	5.8E-01 C	1.6E+00 C	5.2E+00 C	6.1E-03 C	6.1E-02 C	
Methyl isobutyl ketone	108-10-1		7.6E+02 N	7.9E+02 N	2.8E+03 N	2.9E+03 N	8.3E+01 N	1.6E+02 N	
Methyl mercaptan	74-93-1		3.5E+01 N	4.5E+01 N	3.6E+02 N	1.2E+03 N	2.1E+00 N	2.1E+01 N	
Methyl methacrylate	80-62-6		2.2E+03 N	2.2E+03 N	2.7E+03 sat	2.7E+03 sat	7.3E+02 N	1.4E+03 N	
2-Methyl-5-nitroaniline	99-55-8		1.5E+01 C	1.9E+01 C	5.3E+01 C	1.7E+02 C	2.0E-01 C	2.0E+00 C	
Methyl parathion	298-00-0		1.5E+01 N	2.0E+01 N	1.6E+02 N	5.1E+02 N	9.1E-01 N	9.1E+00 N	

EPA REGION 6- HUMAN HEALTH MEDIUM-SPECIFIC SCREENING LEVELS

Basis: C=carcinogenic effects
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sat= soil saturation concentration
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Contaminant	CAS No.	MCL or Action Level	Risk-Based Screening Levels						Soil Screening Level- Transfers from Soil to: Ground water (DAF=1)
			Soil (ingestion, inhalation, with and without dermal exposure routes)				Ambient Air (Residential Scenario)	Tap Water (Residential Scenario: Ingestion & Inhalation)	
			Residential	Residential w/o dermal	Industrial	Industrial w/o dermal			
		ug/l	mg/kg	mg/kg	mg/kg	mg/kg	ug/m3	ug/l	mg/kg
2-Methylphenol	95-48-7		3.0E+03 N	3.9E+03 N	3.1E+04 N	1.0E+05 max	1.8E+02 N	1.8E+03 N	8.0E-01
3-Methylphenol	108-39-4		3.0E+03 N	3.9E+03 N	3.1E+04 N	1.0E+05 max	1.8E+02 N	1.8E+03 N	
4-Methylphenol	106-44-5		3.0E+02 N	3.9E+02 N	3.1E+03 N	1.0E+04 N	1.8E+01 N	1.8E+02 N	
Methyl phosphonic acid	993-13-5		1.2E+03 N	1.6E+03 N	1.2E+04 N	4.1E+04 N	7.3E+01 N	7.3E+02 N	
Methyl styrene (mixture)	25013-15-4		1.2E+02 N	1.3E+02 N	5.1E+02 N	5.6E+02 N	4.2E+01 N	6.0E+01 N	
Methyl styrene (alpha)	98-83-9		6.8E+02 sat	6.8E+02 sat	6.8E+02 sat	6.8E+02 sat	2.6E+02 N	4.3E+02 N	
Methyl tertbutyl ether (MTBE)	1634-04-4						3.1E+03 N	2.0E+01	
Metolaclor (Dual)	51218-45-2		9.1E+03 N	1.2E+04 N	9.3E+04 N	1.0E+05 max	5.5E+02 N	5.5E+03 N	
Mirex	2385-85-5		2.7E-01 C	3.6E-01 C	9.7E-01 C	3.2E+00 C	3.7E-03 C	3.7E-02 C	
Molybdenum	7439-98-7		3.9E+02 N	3.9E+02 N	1.0E+04 N	1.0E+04 N		1.8E+02 N	
Monochloramine	10599-90-3		6.1E+03 N	7.8E+03 N	6.2E+04 N	1.0E+05 max	3.7E+02 N	3.7E+03 N	
Naled	300-76-5		1.2E+02 N	1.6E+02 N	1.2E+03 N	4.1E+03 N	7.3E+00 N	7.3E+01 N	
Nickel and compounds	7440-02-0	1.0E+02	1.6E+03 N	1.6E+03 N	4.1E+04 N	4.1E+04 N		7.3E+02 N	7.0E+00
Nickel refinery dust	n/a		1.1E+04 C	1.1E+04 C	2.2E+04 C	2.2E+04 C	8.0E-03 C		
Nickel subsulfide	12035-72-2		5.2E+03 C	5.2E+03 C	1.1E+04 C	1.1E+04 C	4.0E-03 C		
Nitrate	14797-55-8	1.0E+04						1.0E+04	
Nitric Oxide	10102-43-9		6.1E+03 N	7.8E+03 N	6.2E+04 N	1.0E+05 max		3.7E+03 N	
Nitrite	14797-65-0	1.0E+03						1.0E+03	
2-Nitroaniline	88-74-4		3.6E+00 N	4.7E+00 N	3.7E+01 N	1.2E+02 N	2.1E-01 N	2.2E+00 N	
Nitrobenzene	98-95-3		1.7E+01 N	2.0E+01 N	9.1E+01 N	1.1E+02 N	2.1E+00 N	3.4E+00 N	7.0E-03
Nitrofurantoin	67-20-9		4.2E+03 N	5.5E+03 N	4.4E+04 N	1.0E+05 max	2.6E+02 N	2.6E+03 N	
Nitrofurazone	59-87-0		3.2E-01 C	4.3E-01 C	1.2E+00 C	3.8E+00 C	7.2E-04 C	4.5E-02 C	
Nitrogen dioxide	101102-44-0		6.1E+04 N	7.8E+04 N	1.0E+05 max	1.0E+05 max		3.7E+04 N	
4-Nitrophenol	100-02-7		3.8E+03 N	4.8E+03 N	3.9E+04 N	1.0E+05 max	2.3E+02 N	2.3E+03 N	
2-Nitropropane	79-46-9		5.1E-02 C	6.8E-02 C	1.9E-01 C	6.1E-01 C	7.2E-04 C	1.2E-03 C	
N-Nitrosodi-n-butylamine	924-16-3		2.3E-02 C	2.4E-02 C	5.4E-02 C	6.2E-02 C	1.2E-03 C	2.0E-03 C	

EPA REGION 6- HUMAN HEALTH MEDIUM-SPECIFIC SCREENING LEVELS

Basis: C=carcinogenic effects
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Contaminant	CAS No.	MCL or Action Level	Risk-Based Screening Levels						Soil Screening Level- Transfers from Soil to: Ground water (DAF=1)
			Soil (ingestion, inhalation, with and without dermal exposure routes)				Ambient Air (Residential Scenario)	Tap Water (Residential Scenario: Ingestion & Inhalation)	
			Residential	Residential w/o dermal	Industrial	Industrial w/o dermal			
		ug/l	mg/kg	mg/kg	mg/kg	mg/kg	ug/m3	ug/l	mg/kg
N-Nitrosodiethanolamine	1116-54-7		1.7E-01 C	2.3E-01 C	6.2E-01 C	2.0E+00 C	2.4E-03 C	2.4E-02 C	
N-Nitrosodiethylamine	55-18-5		3.2E-03 C	4.3E-03 C	1.2E-02 C	3.8E-02 C	4.5E-05 C	4.5E-04 C	
N-Nitrosodimethylamine	62-75-9		9.5E-03 C	1.3E-02 C	3.4E-02 C	1.1E-01 C	1.4E-04 C	1.3E-03 C	
N-Nitrosodiphenylamine	86-30-6		9.9E+01 C	1.3E+02 C	3.6E+02 C	1.2E+03 C	1.4E+00 C	1.4E+01 C	6.0E-02
N-Nitroso di-n-propylamine	621-64-7		6.9E-02 C	9.1E-02 C	2.5E-01 C	8.2E-01 C	9.6E-04 C	9.6E-03 C	2.0E-06
N-Nitroso-N-methylethylamine	10595-95-6		2.2E-02 C	2.9E-02 C	7.9E-02 C	2.6E-01 C	3.1E-04 C	3.1E-03 C	
N-Nitrosopyrrolidine	930-55-2		2.3E-01 C	3.0E-01 C	8.3E-01 C	2.7E+00 C	3.1E-03 C	3.2E-02 C	
m-Nitrotoluene	99-08-1		6.1E+02 N	7.8E+02 N	6.2E+03 N	2.0E+04 N	3.7E+01 N	3.7E+02 N	
o-Nitrotoluene	99-08-1		6.1E+02 N	7.8E+02 N	6.2E+03 N	2.0E+04 N	3.7E+01 N	3.7E+02 N	
p-Nitrotoluene	99-99-0		6.1E+02 N	7.8E+02 N	6.2E+03 N	2.0E+04 N	3.7E+01 N	3.7E+02 N	
NuStar	85509-19-9		4.2E+01 N	5.5E+01 N	4.4E+02 N	1.4E+03 N	2.6E+00 N	2.6E+01 N	
Octahydro-1357-tetranitro-1357- tetrazocine (HMX)	2691-41-0		3.0E+03 N	3.9E+03 N	3.1E+04 N	1.0E+05 max	1.8E+02 N	1.8E+03 N	
Oryzalin	19044-88-3		3.0E+03 N	3.9E+03 N	3.1E+04 N	1.0E+05 max	1.8E+02 N	1.8E+03 N	
Oxadiazon	19666-30-9		3.0E+02 N	3.9E+02 N	3.1E+03 N	1.0E+04 N	1.8E+01 N	1.8E+02 N	
Oxamyl	23135-22-0	2.0E+02	1.5E+03 N	2.0E+03 N	1.6E+04 N	5.1E+04 N	9.1E+01 N	9.1E+02 N	
Oxyfluorfen	42874-03-3		1.8E+02 N	2.3E+02 N	1.9E+03 N	6.1E+03 N	1.1E+01 N	1.1E+02 N	
Paraquat	4685-14-7		2.7E+02 N	3.5E+02 N	2.8E+03 N	9.2E+03 N	1.6E+01 N	1.6E+02 N	
Parathion	56-38-2		3.6E+02 N	4.7E+02 N	3.7E+03 N	1.2E+04 N	2.2E+01 N	2.2E+02 N	
Pentachlorobenzene	608-93-5		4.9E+01 N	6.3E+01 N	5.0E+02 N	1.6E+03 N	2.9E+00 N	2.9E+01 N	
Pentachloronitrobenzene	82-68-8		1.9E+00 C	2.5E+00 C	6.7E+00 C	2.2E+01 C	2.6E-02 C	2.6E-01 C	
Pentachlorophenol	87-86-5	1.0E+00	2.9E+00 C	5.3E+00 C	7.1E+00 C	4.8E+01 C	5.6E-02 C	5.6E-01 C	1.0E-03
Perchlorate	7601-90-3		3.9E+01 N	3.9E+01 N	1.0E+03 N	1.0E+03 N		1.8E+01 N	
Permethrin	52645-53-1		3.0E+03 N	3.9E+03 N	3.1E+04 N	1.0E+05 max	1.8E+02 N	1.8E+03 N	
Phenol	108-95-2		3.6E+04 N	4.7E+04 N	1.0E+05 max	1.0E+05 max	2.2E+03 N	2.2E+04 N	5.0E+00

EPA REGION 6- HUMAN HEALTH MEDIUM-SPECIFIC SCREENING LEVELS

Basis: C=carcinogenic effects
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Contaminant	CAS No.	MCL or Action Level	Risk-Based Screening Levels						Soil Screening Level- Transfers from Soil to: Ground water (DAF=1)	
			Soil (ingestion, inhalation, with and without dermal exposure routes)				Ambient Air (Residential Scenario)	Tap Water (Residential Scenario: Ingestion & Inhalation)		
			Residential	Residential w/o dermal	Industrial	Industrial w/o dermal				
		ug/l	mg/kg	mg/kg	mg/kg	mg/kg	ug/m3	ug/l	mg/kg	
Phenothiazine	92-84-2		1.2E+02 N	1.6E+02 N	1.2E+03 N	4.1E+03 N	7.3E+00 N	7.3E+01 N		
m-Phenylenediamine	108-45-2		3.6E+02 N	4.7E+02 N	3.7E+03 N	1.2E+04 N	2.2E+01 N	2.2E+02 N		
p-Phenylenediamine	106-50-3		1.2E+04 N	1.5E+04 N	1.0E+05 max	1.0E+05 max	6.9E+02 N	6.9E+03 N		
Phenylmercuric acetate	62-38-4		4.9E+00 N	6.3E+00 N	5.0E+01 N	1.6E+02 N	2.9E-01 N	2.9E+00 N		
2-Phenylphenol	90-43-7		2.5E+02 C	3.3E+02 C	9.0E+02 C	2.9E+03 C	3.5E+00 C	3.5E+01 C		
Phosphine	7803-51-2		1.8E+01 N	2.3E+01 N	1.9E+02 N	6.1E+02 N	3.1E-01 N	1.1E+01 N		
Phosphoric acid	7664-38-2						1.0E+01 N			
Phosphorus (white)	7723-14-0		1.6E+00 N	1.6E+00 N	4.1E+01 N	4.1E+01 N		7.3E-01 N		
p-Phthalic acid	100-21-0		6.1E+04 N	7.8E+04 N	1.0E+05 max	1.0E+05 max	3.7E+03 N	3.7E+04 N		
Phthalic anhydride	85-44-9		1.0E+05 max	1.0E+05 max	1.0E+05 max	1.0E+05 max	1.2E+02 N	7.3E+04 N		
Polybrominated biphenyls			5.4E-02 C	7.2E-02 C	2.0E-01 C	6.4E-01 C	7.6E-04 C	7.6E-03 C		
Polychlorinated biphenyls (PCBs)	1336-36-3	5.0E-01	2.2E-01 C	3.2E-01 C	6.8E-01 C	2.9E+00 C	3.4E-03 C	3.4E-02 C		
Aroclor 1016	12674-11-2		3.9E+00 N	5.5E+00 N	3.4E+01 N	1.4E+02 N	2.6E-01 N	2.6E+00 N		
Aroclor 1254	11097-69-1		1.1E+00 N	1.6E+00 N	9.8E+00 N	4.1E+01 N	7.3E-02 N	7.3E-01 N		
Polynuclear aromatic hydrocarbons										
Acenaphthene	83-32-9		2.8E+03 N	3.7E+03 N	2.0E+04 N	3.8E+04 N	2.2E+02 N	3.7E+02 N	2.9E+01	
Anthracene	120-12-7		1.6E+04 N	2.2E+04 N	1.0E+05 max	1.0E+05 max	1.1E+03 N	1.8E+03 N	5.9E+02	
Benz[a]anthracene	56-55-3		6.2E-01 C	8.8E-01 C	2.0E+00 C	7.8E+00 C	2.2E-02 C	9.2E-02 C	8.0E-02	
Benzo[b]fluoranthene	205-99-2		6.2E-01 C	8.8E-01 C	2.0E+00 C	7.8E+00 C	2.2E-02 C	9.2E-02 C	2.0E-01	
Benzo[k]fluoranthene	207-08-9		6.2E+00 C	8.8E+00 C	2.0E+01 C	7.8E+01 C	2.2E-01 C	9.2E-01 C	2.0E+00	
Benzo[a]pyrene	50-32-8	2.0E-01	6.2E-02 C	8.8E-02 C	2.0E-01 C	7.8E-01 C	2.2E-03 C	9.2E-03 C	4.0E-01	
Chrysene	218-01-9		6.2E+01 C	8.8E+01 C	2.0E+02 C	7.8E+02 C	2.2E+00 C	9.2E+00 C	8.0E+00	
Dibenz[ah]anthracene	53-70-3		6.2E-02 C	8.8E-02 C	2.0E-01 C	7.8E-01 C	2.2E-03 C	9.2E-03 C	8.0E-02	
Fluoranthene	206-44-0		2.3E+03 N	3.1E+03 N	2.1E+04 N	8.2E+04 N	1.5E+02 N	1.5E+03 N	2.1E+02	
Fluorene	86-73-7		2.0E+03 N	2.6E+03 N	1.5E+04 N	3.3E+04 N	1.5E+02 N	2.4E+02 N	2.8E+01	
Indeno[1,2,3-cd]pyrene	193-39-5		6.2E-01 C	8.8E-01 C	2.0E+00 C	7.8E+00 C	2.2E-02 C	9.2E-02 C	7.0E-01	

EPA REGION 6- HUMAN HEALTH MEDIUM-SPECIFIC SCREENING LEVELS

Basis: C=carcinogenic effects
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Contaminant	CAS No.	MCL or Action Level	Risk-Based Screening Levels								Soil Screening Level- Transfers from Soil to: Ground water (DAF=1)	
			Soil (ingestion, inhalation, with and without dermal exposure routes)				Ambient Air (Residential Scenario)		Tap Water (Residential Scenario: Ingestion & Inhalation)			
			Residential		Residential w/o dermal		Industrial		Industrial w/o dermal			
		ug/l	mg/kg		mg/kg		mg/kg		mg/kg		ug/m3	ug/l	mg/kg	
Naphthalene	91-20-3		5.5E+01	N	5.6E+01	N	1.9E+02	N	1.9E+02	N	3.1E+00	N	6.2E+00	N	4.0E+00
Pyrene	129-00-0		1.7E+03	N	2.3E+03	N	1.5E+04	N	5.4E+04	N	1.1E+02	N	1.8E+02	N	2.1E+02
Prometon	1610-18-0		9.1E+02	N	1.2E+03	N	9.3E+03	N	3.1E+04	N	5.5E+01	N	5.5E+02	N	
Prometryn	7287-19-6		2.4E+02	N	3.1E+02	N	2.5E+03	N	8.2E+03	N	1.5E+01	N	1.5E+02	N	
Propachlor	1918-16-7		7.9E+02	N	1.0E+03	N	8.1E+03	N	2.7E+04	N	4.7E+01	N	4.7E+02	N	
Propanil	709-98-8		3.0E+02	N	3.9E+02	N	3.1E+03	N	1.0E+04	N	1.8E+01	N	1.8E+02	N	
Propargite	2312-35-8		1.2E+03	N	1.6E+03	N	1.2E+04	N	4.1E+04	N	7.3E+01	N	7.3E+02	N	
Propargyl alcohol	107-19-7		1.2E+02	N	1.6E+02	N	1.2E+03	N	4.1E+03	N	7.3E+00	N	7.3E+01	N	
Propazine	139-40-2		1.2E+03	N	1.6E+03	N	1.2E+04	N	4.1E+04	N	7.3E+01	N	7.3E+02	N	
Propiconazole	60207-90-1		7.9E+02	N	1.0E+03	N	8.1E+03	N	2.7E+04	N	4.7E+01	N	4.7E+02	N	
iso-Propylbenzene	104-5-18		1.3E+02	N	1.3E+02	N	3.9E+02	sat	3.9E+02	sat	3.7E+01	N	6.1E+01	N	
n-Propylbenzene	104-51-8		1.4E+02	N	1.4E+02	N	2.4E+02	sat	2.4E+02	sat	3.7E+01	N	6.1E+01	N	
Propylene glycol	57-55-6		1.0E+05	max	1.0E+05	max	1.0E+05	max	1.0E+05	max	7.3E+04	N	7.3E+05	N	
Propylene glycol, monoethyl ether	111-35-3		4.2E+04	N	5.5E+04	N	1.0E+05	max	1.0E+05	max	2.6E+03	N	2.6E+04	N	
Propylene glycol, monomethyl ether	107-98-2		4.2E+04	N	5.5E+04	N	1.0E+05	max	1.0E+05	max	2.1E+03	N	2.6E+04	N	
Propylene oxide	75-56-9		1.6E+00	C	1.9E+00	C	4.9E+00	C	9.1E+00	C	5.2E-01	C	2.2E-01	C	
Pursuit	81335-77-5		1.5E+04	N	2.0E+04	N	1.0E+05	max	1.0E+05	max	9.1E+02	N	9.1E+03	N	
Pyridine	110-86-1		6.1E+01	N	7.8E+01	N	6.2E+02	N	2.0E+03	N	3.7E+00	N	3.7E+01	N	
Quinoline	91-22-5		4.0E-02	C	5.3E-02	C	1.5E-01	C	4.8E-01	C	5.6E-04	C	5.6E-03	C	
RDX (Cyclonite)	121-82-4		4.4E+00	C	5.8E+00	C	1.6E+01	C	5.2E+01	C	6.1E-02	C	6.1E-01	C	
Resmethrin	10453-86-8		1.8E+03	N	2.3E+03	N	1.9E+04	N	6.1E+04	N	1.1E+02	N	1.1E+03	N	
Ronnel	299-84-3		3.0E+03	N	3.9E+03	N	3.1E+04	N	1.0E+05	max	1.8E+02	N	1.8E+03	N	
Rotenone	83-79-4		2.4E+02	N	3.1E+02	N	2.5E+03	N	8.2E+03	N	1.5E+01	N	1.5E+02	N	
Selenious Acid	7783-00-8		3.0E+02	N	3.9E+02	N	3.1E+03	N	1.0E+04	N			1.8E+02	N	
Selenium	7782-49-2	5.0E+01	3.9E+02	N	3.9E+02	N	1.0E+04	N	1.0E+04	N			1.8E+02	N	3.0E-01

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Contaminant	CAS No.	MCL or Action Level	Risk-Based Screening Levels						Soil Screening Level- Transfers from Soil to: Ground water (DAF=1)
			Soil (ingestion, inhalation, with and without dermal exposure routes)				Ambient Air (Residential Scenario)	Tap Water (Residential Scenario: Ingestion & Inhalation)	
			Residential	Residential w/o dermal	Industrial	Industrial w/o dermal			
		ug/l	mg/kg	mg/kg	mg/kg	mg/kg	ug/m3	ug/l	mg/kg
Silver and compounds	7440-22-4		3.9E+02 N	3.9E+02 N	1.0E+04 N	1.0E+04 N		1.8E+02 N	2.0E+00
Simazine	122-34-9	4.0E+00	4.0E+00 C	5.3E+00 C	1.5E+01 C	4.8E+01 C	5.6E-02 C	5.6E-01 C	
Sodium azide	26628-22-8		2.4E+02 N	3.1E+02 N	2.5E+03 N	8.2E+03 N	1.5E+01 N	1.5E+02 N	
Sodium diethyldithiocarbamate	148-18-5		1.8E+00 C	2.4E+00 C	6.5E+00 C	2.1E+01 C	2.5E-02 C	2.5E-01 C	
Sodium fluoroacetate	62-74-8		1.2E+00 N	1.6E+00 N	1.2E+01 N	4.1E+01 N	7.3E-02 N	7.3E-01 N	
Sodium metavanadate	13718-26-8		6.1E+01 N	7.8E+01 N	6.2E+02 N	2.0E+03 N	3.7E+00 N	3.7E+01 N	
Strontium, stable	7440-24-6		4.7E+04 N	4.7E+04 N	1.0E+05 max	1.0E+05 max		2.2E+04 N	
Strychnine	57-24-9		1.8E+01 N	2.3E+01 N	1.9E+02 N	6.1E+02 N	1.1E+00 N	1.1E+01 N	
Styrene	100-42-5	1.0E+02	1.7E+03 sat	1.7E+03 sat	1.7E+03 sat	1.7E+03 sat	1.1E+03 N	1.6E+03 N	2.0E-01
2,3,7,8-TCDD (dioxin)	1746-01-6	3.0E-05	3.9E-06 C	4.3E-06 C	2.3E-05 C	3.8E-05 C	4.5E-08 C	4.5E-07 C	
1,2,4,5-Tetrachlorobenzene	95-94-3		1.8E+01 N	2.3E+01 N	1.9E+02 N	6.1E+02 N	1.1E+00 N	1.1E+01 N	
1,1,1,2-Tetrachloroethane	630-20-6		2.9E+00 C	3.0E+00 C	6.6E+00 C	7.1E+00 C	2.6E-01 C	4.3E-01 C	
1,1,2,2-Tetrachloroethane	79-34-5		3.7E-01 C	3.8E-01 C	8.4E-01 C	9.0E-01 C	3.3E-02 C	5.5E-02 C	2.0E-04
Tetrachloroethylene (PCE)	127-18-4	5.0E+00	4.9E+00 C	5.7E+00 C	1.3E+01 C	1.9E+01 C	3.3E+00 C	1.1E+00 C	3.0E-03
2,3,4,6-Tetrachlorophenol	58-90-2		1.8E+03 N	2.3E+03 N	1.9E+04 N	6.1E+04 N	1.1E+02 N	1.1E+03 N	
p,a,a,a-Tetrachlorotoluene	5216-25-1		2.4E-02 C	3.2E-02 C	8.7E-02 C	2.9E-01 C	3.4E-04 C	3.4E-03 C	
Tetrachlorovinphos	961-11-5		2.0E+01 C	2.7E+01 C	7.3E+01 C	2.4E+02 C	2.8E-01 C	2.8E+00 C	
Tetrahydrofuran	109-99-9		5.2E+03 N	6.7E+03 N	5.3E+04 N	1.0E+05 max	3.1E+02 N	3.1E+03 N	
Thallic oxide	1314-32-5		5.5E+00 N	5.5E+00 N	1.4E+02 N	1.4E+02 N		2.6E+00 N	
Thallium acetate	563-68-8	2.0E+00	7.0E+00 N	7.0E+00 N	1.8E+02 N	1.8E+02 N		3.3E+00 N	4.0E-01
Thallium carbonate	6533-73-9	2.0E+00	6.3E+00 N	6.3E+00 N	1.6E+02 N	1.6E+02 N		2.9E+00 N	4.0E-01
Thallium chloride	7791-12-0	2.0E+00	6.3E+00 N	6.3E+00 N	1.6E+02 N	1.6E+02 N		2.9E+00 N	4.0E-01
Thallium nitrate	10102-45-1	2.0E+00	7.0E+00 N	7.0E+00 N	1.8E+02 N	1.8E+02 N		3.3E+00 N	4.0E-01
Thallium selenite	12039-52-0	2.0E+00	7.0E+00 N	7.0E+00 N	1.8E+02 N	1.8E+02 N		3.3E+00 N	4.0E-01
Thallium sulfate	7446-18-6	2.0E+00	6.3E+00 N	6.3E+00 N	1.6E+02 N	1.6E+02 N		2.9E+00 N	4.0E-01

EPA REGION 6- HUMAN HEALTH MEDIUM-SPECIFIC SCREENING LEVELS

Basis: C=carcinogenic effects
N=non-carcinogenic effects
sat= soil saturation concentration
max= maximum concentration

Contaminant	CAS No.	MCL or Action Level	Risk-Based Screening Levels										Soil Screening Level- Transfers from Soil to: Ground water (DAF=1)
			Soil (ingestion, inhalation, with and without dermal exposure routes)								Ambient Air (Residential Scenario)		Tap Water (Residential Scenario: Ingestion & Inhalation)		
			Residential		Residential w/o dermal		Industrial		Industrial w/o dermal						
		ug/l	mg/kg		mg/kg		mg/kg		mg/kg		ug/m3		ug/l		mg/kg
Thiobencarb	28249-77-6		6.1E+02	N	7.8E+02	N	6.2E+03	N	2.0E+04	N	3.7E+01	N	3.7E+02	N	
Thiocyanate	N/A		6.1E+03	N	7.8E+03	N	6.2E+04	N	1.0E+05	max	3.7E+02	N	3.7E+03	N	
Tin and compounds	N/A		4.7E+04	N	4.7E+04	N	1.0E+05	max	1.0E+05	max			2.2E+04	N	
Toluene	108-88-3	1.0E+03	5.2E+02	sat	5.2E+02	sat	5.2E+02	sat	5.2E+02	sat	4.0E+02	N	7.2E+02	N	6.0E-01
Toluene-2,4-diamine	95-80-7		1.5E-01	C	2.0E-01	C	5.5E-01	C	1.8E+00	C	2.1E-03	C	2.1E-02	C	
Toluene-2,5-diamine	95-70-5		3.6E+04	N	4.7E+04	N	1.0E+05	max	1.0E+05	max	2.2E+03	N	2.2E+04	N	
Toluene-2,6-diamine	823-40-5		1.2E+04	N	1.6E+04	N	1.0E+05	max	1.0E+05	max	7.3E+02	N	7.3E+03	N	
p-Toluidine	106-49-0		2.5E+00	C	3.4E+00	C	9.2E+00	C	3.0E+01	C	3.5E-02	C	3.5E-01	C	
Toxaphene	8001-35-2	3.0E+00	4.4E-01	C	5.8E-01	C	1.6E+00	C	5.2E+00	C	6.0E-03	C	6.1E-02	C	2.0E+00
1,2,4-Tribromobenzene	615-54-3		3.0E+02	N	3.9E+02	N	3.1E+03	N	1.0E+04	N	1.8E+01	N	1.8E+02	N	
Tributyltin oxide (TBTO)	56-35-9		1.8E+01	N	2.3E+01	N	1.9E+02	N	6.1E+02	N			1.1E+01	N	
2,4,6-Trichloroaniline	634-93-5		1.4E+01	C	1.9E+01	C	5.1E+01	C	1.7E+02	C	2.0E-01	C	2.0E+00	C	
1,2,4-Trichlorobenzene	120-82-1	7.0E+01	5.2E+02	N	6.5E+02	N	3.0E+03	sat	3.0E+03	sat	2.1E+02	N	1.9E+02	N	3.0E-01
1,1,1-Trichloroethane	71-55-6	2.0E+02	7.1E+02	N	7.7E+02	N	1.4E+03	sat	1.4E+03	sat	1.0E+03	N	7.9E+02	N	1.0E-01
1,1,2-Trichloroethane	79-00-5	5.0E+00	8.2E-01	C	8.4E-01	C	1.8E+00	C	1.9E+00	C	1.2E-01	C	2.0E-01	C	9.0E-04
Trichloroethylene (TCE)	79-01-6	5.0E+00	2.7E+00	C	2.8E+00	C	6.0E+00	C	6.1E+00	C	1.1E+00	C	1.6E+00	C	3.0E-03
Trichlorofluoromethane	75-69-4		3.8E+02	N	3.9E+02	N	1.3E+03	N	1.3E+03	N	7.3E+02	N	1.3E+03	N	
2,4,5-Trichlorophenol	95-95-4		6.1E+03	N	7.8E+03	N	6.2E+04	N	1.0E+05	max	3.7E+02	N	3.7E+03	N	1.4E+01
2,4,6-Trichlorophenol	88-06-2		4.4E+01	C	5.8E+01	C	1.6E+02	C	5.2E+02	C	6.2E-01	C	6.1E+00	C	8.0E-03
2,4,5-Trichlorophenoxyacetic Acid	93-76-5		6.1E+02	N	7.8E+02	N	6.2E+03	N	2.0E+04	N	3.7E+01	N	3.7E+02	N	
2-(2,4,5-Trichlorophenoxy) propionic acid	93-72-1		4.9E+02	N	6.3E+02	N	5.0E+03	N	1.6E+04	N	2.9E+01	N	2.9E+02	N	
1,1,2-Trichloropropane	598-77-6		1.5E+01	N	1.5E+01	N	5.1E+01	N	5.1E+01	N	1.8E+01	N	3.0E+01	N	
1,2,3-Trichloropropane	96-18-4		1.4E-03	C	1.4E-03	C	3.1E-03	C	3.1E-03	C	9.6E-04	C	1.6E-03	C	
1,2,3-Trichloropropene	96-19-5		1.1E+01	N	1.2E+01	N	3.8E+01	N	3.9E+01	N	1.8E+01	N	3.0E+01	N	

EPA REGION 6- HUMAN HEALTH MEDIUM-SPECIFIC SCREENING LEVELS

Basis: C=carcinogenic effects
N=non-carcinogenic effects
sat= soil saturation concentration
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Contaminant	CAS No.	MCL or Action Level	Risk-Based Screening Levels						Soil Screening Level- Transfers from Soil to: Ground water (DAF=1)
			Soil (ingestion, inhalation, with and without dermal exposure routes)				Ambient Air (Residential Scenario)	Tap Water (Residential Scenario: Ingestion & Inhalation)	
			Residential	Residential w/o dermal	Industrial	Industrial w/o dermal			
		ug/l	mg/kg	mg/kg	mg/kg	mg/kg	ug/m3	ug/l	mg/kg
1,1,2-Trichloro-1,2,2-trifluoroethane	76-13-1		5.6E+03 sat	5.6E+03 sat	5.6E+03 sat	5.6E+03 sat	3.1E+04 N	5.9E+04 N	
Triethylamine	121-44-8		2.2E+01 N	2.3E+01 N	8.4E+01 N	8.8E+01 N	7.3E+00 N	1.2E+01 N	
1,2,4-Trimethylbenzene	95-63-6		5.2E+01 N	5.2E+01 N	1.7E+02 N	1.7E+02 N	6.2E+00 N	1.2E+01 N	
1,3,5-Trimethylbenzene	108-67-8		2.1E+01 N	2.1E+01 N	7.0E+01 N	7.0E+01 N	6.2E+00 N	1.2E+01 N	
Trimethyl phosphate	512-56-1		1.3E+01 C	1.7E+01 C	4.7E+01 C	1.5E+02 C	1.8E-01 C	1.8E+00 C	
1,3,5-Trinitrobenzene	99-35-4		1.8E+03 N	2.3E+03 N	1.9E+04 N	6.1E+04 N	1.1E+02 N	1.1E+03 N	
Trinitrophenylmethyl-nitramine	479-45-8		6.1E+02 N	7.8E+02 N	6.2E+03 N	2.0E+04 N	3.7E+01 N	3.7E+02 N	
2,4,6-Trinitrotoluene	118-96-7		1.6E+01 C	2.1E+01 C	5.8E+01 C	1.9E+02 C	2.2E-01 C	2.2E+00 C	
Vanadium	7440-62-2		5.5E+02 N	5.5E+02 N	1.4E+04 N	1.4E+04 N		2.6E+02 N	3.0E+02
Vanadium pentoxide	1314-62-1		7.0E+02 N	7.0E+02 N	1.8E+04 N	1.8E+04 N		3.3E+02 N	3.0E+02
Vanadium sulfate	13701-70-7		1.6E+03 N	1.6E+03 N	4.1E+04 N	4.1E+04 N		7.3E+02 N	3.0E+02
Vinclozolin	50471-44-8		1.5E+03 N	2.0E+03 N	1.6E+04 N	5.1E+04 N	9.1E+01 N	9.1E+02 N	
Vinyl acetate	108-05-4		4.3E+02 N	4.3E+02 N	1.4E+03 N	1.4E+03 N	2.1E+02 N	4.1E+02 N	8.0E+00
Vinyl bromide	593-60-2		1.9E-01 C	1.9E-01 C	4.1E-01 C	4.2E-01 C	6.1E-02 C	1.0E-01 C	
Vinyl chloride	75-01-4	2.0E+00	2.1E-02 C	2.2E-02 C	4.7E-02 C	4.9E-02 C	2.2E-02 C	2.0E-02 C	7.0E-04
Warfarin	81-81-2		1.8E+01 N	2.3E+01 N	1.9E+02 N	6.1E+02 N	1.1E+00 N	1.1E+01 N	
m-Xylene	108-38-3		2.1E+02 sat	2.1E+02 sat	2.1E+02 sat	2.1E+02 sat	7.3E+02 N	1.4E+03 N	1.0E+01
o-Xylene	95-47-6		2.8E+02 sat	2.8E+02 sat	2.8E+02 sat	2.8E+02 sat	7.3E+02 N	1.4E+03 N	9.0E+00
p-Xylene	106-42-3		3.7E+02 sat	3.7E+02 sat	3.7E+02 sat	3.7E+02 sat			1.0E+01
Zinc	7440-66-6		2.3E+04 N	2.3E+04 N	1.0E+05 max	1.0E+05 max		1.1E+04 N	6.2E+02
Zinc phosphide	1314-84-7		2.3E+01 N	2.3E+01 N	6.1E+02 N	6.1E+02 N		1.1E+01 N	
Zineb	12122-67-7		3.0E+03 N	3.9E+03 N	3.1E+04 N	1.0E+05 max	1.8E+02 N	1.8E+03 N	

Risk-based Screening Levels for Radionuclides in Soil (from EPA/NRC MOU) pCi/g = picocuries per gram

MOU Table 1: Consultation Triggers for Residential and Commercial/Industrial Soil Contamination

Except for radium-226, thorium-232, or total uranium, concentrations should be aggregated using a sum of the fraction approach to determine site specific consultation trigger concentrations. This table is based on single contaminant concentrations for residential and commercial/industrial land use when using generally accepted exposure parameters. Table users should select the appropriate column based on the site's reasonably anticipated land use.

Radionuclide	Residential Soil Concentration	Industrial/Commercial Soil Concentration
H-3	228 pCi/g	423 pCi/g
C-14	46 pCi/g	123,000 pCi/g
Na-22	9 pCi/g	14 pCi/g
S-35	19,600 pCi/g	32,200,000 pCi/g
Cl-36	6 pCi/g	10,700 pCi/g
Ca-45	13,500 pCi/g	3,740,000 pCi/g
Sc-46	105 pCi/g	169 pCi/g
Mn-54	69 pCi/g	112 pCi/g
Fe-55	269,000 pCi/g	2,210,000 pCi/g
Co-57	873 pCi/g	1,420 pCi/g
Co-60	4 pCi/g	6 pCi/g
Ni-59	20,800 pCi/g	1,230,000 pCi/g
Ni-63	9,480 pCi/g	555,000 pCi/g
Sr-90+D	23 pCi/g	1,070 pCi/g
Nb-94	2 pCi/g	3 pCi/g
Tc-99	25 pCi/g	89,400 pCi/g
I-129	60 pCi/g	1,080 pCi/g
Cs-134	16 pCi/g	26 pCi/g
Cs-137+D	6 pCi/g	11 pCi/g
Eu-152	4 pCi/g	7 pCi/g
Eu-154	5 pCi/g	8 pCi/g

MOU Table 1: Consultation Triggers for Residential and Commercial/Industrial Soil Contamination

Except for radium-226, thorium-232, or total uranium, concentrations should be aggregated using a sum of the fraction approach to determine site specific consultation trigger concentrations. This table is based on single contaminant concentrations for residential and commercial/industrial land use when using generally accepted exposure parameters. Table users should select the appropriate column based on the site's reasonably anticipated land use.

Radionuclide	Residential Soil Concentration	Industrial/Commercial Soil Concentration
Ir-192	336 pCi/g	544 pCi/g
Pb-210+D	15 pCi/g	123 pCi/g
Ra-226	5 pCi/g	5 pCi/g
Ac-227+D	10 pCi/g	21 pCi/g
Th-228+D	15 pCi/g	25 pCi/g
Th-232	5 pCi/g	5 pCi/g
U-234	401 pCi/g	3,310 pCi/g
U-235+D	20 pCi/g	39 pCi/g
U-238+D	74 pCi/g	179 pCi/g
total uranium	47 mg/kg	1230 mg/kg
Pu-238	297 pCi/g	1,640 pCi/g
Pu-239	259 pCi/g	1,430 pCi/g
Pu-241	40,600 pCi/g	172,000 pCi/g
Am-241	187 pCi/g	568 pCi/g
Cm-242	32,200 pCi/g	344,000 pCi/g
Cm-243	35 pCi/g	67 pCi/g

[redacted]

compound not on EPA's medium specific screening level list	compound to use as a substitute
chloroethane	
cyclohexane	
methylcyclohexane	
cis-1,3-dichloropropene	1,3-dichloropropene (542-75-6)
trans-1,3-dichloropropene	1,3-dichloropropene (542-75-6)
2-hexanone (butylmethylketone)	
isopropylbenzene	
2-~~nitrophenol~~	4-Nitrophenol
bis(2-chloroethoxy)methane	bis(2-Chloroethyl) ether
~~naphthalene~~	
4-chloro-3-methylphenol	3-Methylphenol (~~p-chloro-m-cresol~~)
2-methylnaphthalene	
~~acenaphthylene~~ acenaphthylene	Pyrene
3-nitroanilene	
~~acenaphthene~~	
~~fluorene~~	
4-chlorophenylphenylether	
4-nitroaniline	
4,6-dintro-2-methylphenol	
4-bromophenyl phenylether	
phenanthrene	Pyrene
~~anthracene~~	
Di-n-butylphthalate	Dibutyl Phthalate
~~fluoranthene~~	
benzo(g,h,i)perylene	Pyrene
delta-BHC (HCH)	Alpha-BHC
Endosulfan I	Endosulfan
Endosulfan II	Endosulfan
Endosulfan sulfate	Endosulfan
Endrin ketone	Endrin
Endrin aldehyde	Endrin
alpha-Chlordane	Chlordane
gamma-Chlordane	Chlordane

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HEAVY METALS IN SOILS

edited by

Dr B.J. ALLOWAY
Senior Lecturer in Environmental Science, Queen Mary and Westfield College, University of London

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Preface

Heavy metals are important in several ways: many are used industrially in technologically advanced countries, some are physiologically essential for plants and animals—and thus have a direct bearing on human health and agricultural productivity—and many are significant as pollutants of ecosystems throughout the world. Heavy metals in soils have received increasing attention in recent years, partly because of the growing scientific and public awareness of environmental issues, and partly because of the development of analytical techniques to measure their concentrations accurately. Atomic absorption spectrophotometry, for example, allows large numbers of samples to be analysed rapidly and accurately and thereby facilitates environmental monitoring.

Surveys carried out since the 1960s have indicated that soils in many parts of the world, especially in urban and industrial areas, contain anomalously high concentrations of heavy metals. Although in most cases the levels are not (yet) high enough to cause acute toxicity problems, increased concentrations in the food chain may cause significant health effects in the long term. Metals which accumulate in the human body, such as Cd and Pb, are a particular cause for concern. There have been reports of deaths and illness related to environmental Cd and Hg poisoning, and elevated levels of Pb in the blood of infants are becoming more common. These findings have provided a stimulus for more comprehensive studies of known or suspected areas of pollution and for complementary investigations of the chemical behaviour of heavy metals in soils and their uptake by plants.

Traditionally research by soil chemists has been concerned primarily with plant macronutrients (N, P and K) and little work was done on many of the heavy metals until recently. Although acute toxic effects of heavy metals on animals and plants have been recognised for a long time, the level of chronic accumulation of many metals in soils and ecosystems has come to be appreciated only in the last twenty years.

Soils are dynamic bodies in equilibrium with the environmental forces acting upon them. Climatic changes will affect the balance of interacting soil processes; the 'greenhouse effect' for example, together with increased acid precipitation ('acid rain'), will cause changes in the bioavailability of metals. The soil is a vital ecological and agricultural resource and needs to be protected against further degradation. The world's increasing population needs an adequate supply of healthy food, and heavy metals can affect both

5 Arsenic

P. O'NEILL

5.1 Introduction

Arsenic has achieved great notoriety because of the toxic properties of a number of its compounds. Fortunately there are great differences in the toxicity of different compounds, and the species that are most commonly found in soils are not the most toxic. The uptake of As by many terrestrial plants is not very great so that, even on relatively high As soils, plants do not usually contain dangerous levels of As.

Arsenic compounds appear to have been used by humans for several thousand years. Kipling [1] provides a general account of the history of As usage (and abusage) and reviews [2, 3, 4] of health effects and metabolic changes in animals, plants and humans give more details than can be provided in this short chapter.

The major present-day uses of As compounds are as pesticides, wood preservatives, and as growth promoters for poultry and pigs.

A recent review [5] of the global cycling of As suggested that natural inputs to the atmosphere were 45 000 t As/yr whereas anthropogenic sources added 28 000 t As/yr. In soils the natural levels are dependent on the source rock type, and the normal range is 1–40 mg As/kg with most soils being in the lower half of this range [6, 7, 8, 9]. Levels may be elevated due to mineralisation, contamination from industrial activity (especially Cu smelters) and the use of As-based pesticides.

Arsenic differs from many of the common heavy metals in that the majority of the organo As compounds are less toxic than inorganic As compounds. Whilst having many chemical similarities to P, the soil chemistry of As is much more diverse because it can exist in more than one oxidation state under the normal range of soil conditions and As can form bonds with S and C much more readily than does P.

5.2 Geochemical occurrence

Over 200 As-containing minerals have been identified, with approximately 60% being arsenates, 20% sulphides and sulphosalts and the remaining 20%

including arsenides, arsenites, oxides and elemental As [6]. The most common of the As minerals is arsenopyrite, FeAsS, and As is found associated with many types of mineral deposits especially those including sulphide mineralisation [7]. The concentration of associated As can range from a few parts per million up to percentage quantities.

There is relatively little difference in the concentration of As in rocks unless the levels have been raised by associated mineralisation. Mean values of the order of 2 mg/kg appear to be those most commonly found for igneous and sedimentary rocks, but the finer grained argillaceous rocks and phosphorites average 10–15 mg As/kg. Higher levels of As are often associated with the presence of sulphide minerals such as pyrites. The As contents of metamorphic rocks reflect those of the original igneous or sedimentary rocks.

Arsenic has often been used as a 'pathfinding' or indicator element when geochemical prospecting methods have been utilised to identify mineral deposits. It is a particularly good indicator because it is associated with a wide variety of mineral deposits; the general background levels of As in rocks are low; it often forms more volatile and soluble phases than the major elements with which it is associated and therefore the As halo is more widely dispersed; sensitive methods of analysis have been developed. It is especially useful for Au and Ag deposits but is also associated with Bi, Cd, Co, Cu, Fe, Hg, Mo, Ni, Pb, Pt metals, Sb, Se, Sn, U, W and Zn deposits.

Whilst the major simple As minerals such as arsenopyrite, orpiment, As_2S_3, realgar, AsS, and enargite, Cu_3AsS_4, have been mined in their own right as sources of As, nowadays most As is produced as a by-product of the extraction of Cu, Pb, Au and Ag from their ores.

5.3 Origin of arsenic in soils

5.3.1 *Soil parent materials*

There is little difference between the various types of igneous rocks with concentration ranges of < 1–15 mg As/kg. The argillaceous sedimentary rocks (shales, mudstones, slates) have significantly higher As levels (< 1–900 mg/kg), than sandstones and limestones (< 1–20 mg/kg). Phosphate rocks have ranges of < 1–200 m/kg.

The ability of As to bind to S ligands means that it tends to be found associated with sulphide-bearing mineral deposits either as separate As minerals or as a trace or minor constituent of other sulphide minerals. This leads to elevated levels in soils in many mineralised areas.

An overall mean As value for 2691 uncontaminated soils was 10 mg/kg [8]. These values can be compared to those for a mineralised area and its surroundings where the 0–5 cm surface soils had mean concentrations of 424 mg/kg and 29–51 mg/kg for apparently non-mineralised areas also in SW England [10].

It is clear that the general values for uncontaminated soils are significantly higher than for uncontaminated rocks. Whilst it is possible to believe that the weathering of the rocks leads to a relative retention of As in the soils, compared to the leaching out of other elements, the size of this increase is too large when the chemical properties of the relevant As species are considered. Data are generally lacking on As levels in uncontaminated rocks and soils. A survey of As levels in soils in Norway has shown that whilst below the humus layer concentrations are generally below 2 mg/kg the humus layer may contain up to 10 mg/kg which has been interpretated as being due to atmospheric pollution [11]. The effects of atmospheric inputs and extended geochemical anomalies, together with a non-random selection of samples for analysis, could be responsible for the lack of agreement between 'background' rock and soil As concentrations.

5.3.2 *Agricultural materials*

Arsenic compounds have been widely used as pesticides for over a hundred years, but their use is now declining, having probably halved in the decade from 1970 to 1980. The phytotoxic effects of As compounds made them attractive as herbicides and as desiccants to allow cotton to be easily harvested after defoliation. However, there has been concern about the build-up of As residues in soils and lake sediments which has occurred after the use of large quantities of inorganic As compounds. As a consequence other pesticides have replaced As compounds such as lead arsenate, which was commonly used in orchards to control insect pests, and sodium arsenite, which was extensively employed as a herbicide to clear aquatic weeds and defoliate seed potatoes.

Worldwide usage has been recently estimated to be 8000 t As/yr as herbicide, 12 000 t As/yr as cotton desiccant and 16 000 t As/yr in wood preservatives [5]. The rate of application of the pesticides is generally in the range of 2–4 kg As/ha, but larger quantities of dimethylarsinic acid may be used with application rates being up to three times greater [2]. In addition, small quantities of organo As compounds are used as animal feed additives, at the rate of 10–50 mg As/kg feed, to promote growth in chickens, turkeys and pigs. The compounds are rapidly excreted, often with little chemical change having apparently taken place.

Soils have generally been less badly affected by As build-up than aquatic sediments unless lead arsenate has been used, when residuals of 100–200 mg As/kg soil with highs of over 2500 mg As/kg have been reported [12]. The lack of long-term build-up of As in soils has been explained by referring to the production of volatile As compounds by microorganisms and leaching. The mobility of the As in aquatic sediments appears to have been reduced by the presence of abundant hydrated iron oxides and/or sulphide [13].

Phosphate fertilisers are a potential source of As. The concentration of As in the fertiliser will vary with the source of the phosphate rock used to produce

REFERENCE 30

Element Concentrations in Soils and Other Surficial Materials of the Conterminous United States

By HANSFORD T. SHACKLETTE *and* JOSEPHINE G. BOERNGEN

U.S. GEOLOGICAL SURVEY PROFESSIONAL PAPER 1270

An account of the concentrations of 50 chemical elements in samples of soils and other regoliths

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TABLE 1.—*Average or median contents, and range in contents, reported for elements in soils and other surficial materials*

[Data are in parts per million; each average represents arithmetic mean; leaders (—) in figure columns indicate no data available. A, average; M, median. <, less than; >, greater than]

Element	This report		Rose, and others (1979) (elements useful in geochemical prospecting)	Vinogradov (1959) (presumably, averages from worldwide sampling)	Jackson (1964)	Mitchell (1964)	Brooks (1972)
	Average	Range			"Typical",[1] average, or range in values	Range in contents in Scottish surface soils	Average or range
Al	72,000	700 - <10,000		71,300	10,000 - 60,000		
As	7.2	<0.1 - 97	7.5 (M)	5			5
B	33	<20 - 300	29 (M)	10	30		10
Ba	580	10 - 5,000	300 (M)			400 - 3,000	500
Be	.92	<1 - 15	0.5 - 4	6		<5 - 5	6
Br	.85	<0.5 - 11					
C, total	25,000	600 - 370,000		20,000			
Ca	24,000	100 - 320,000		13,700	7,000		
Ce	75	<150 - 300					
Co	9.1	<3 - 70	10 (M)	8		<2 - 80	10
Cr	54	1 - 2,000	6.3 (M)	200		5 - 3,000	200
Cu	25	<1 - 700	15 (M)	20	20	<10 - 100	20
F	430	<10 - 3,700	300 (M)	200			
Fe	26,000	100 - >100,000	21,000 (M)	38,000	7,000 - 42,000		10,000 - 50,000
Ga	17	<5 - 70		30		15 - 70	20
Ge	1.2	<0.1 - 2.5		1			5
Hg	.09	<0.01 - 4.6	0.056 (M)				.01
I	1.2	<0.5 - 9.6					
K	15,000	50 - 63,000	11,000 (M)	13,600	400 - 28,000		
La	37	<30 - 200				<30 - 200	
Li	24	<5 - 140	6.2 (M)	30			30
Mg	9,000	50 - >100,000		6,300	<6,000		
Mn	550	<2 - 7,000	320 (M)	850		200 - 5,000	850
Mo	.97	<3 - 15	2.5 (A)	2		<1 - 5	2.5
Na	12,000	<500 - 100,000		6,300			
Nb	11	<10 - 100	15 (A)				15
Nd	46	<70 - 300					
Ni	19	<5 - 700	17 (M)	40		10 - 800	40
P	430	<20 - 6,800	300 (M)	800	500		
Pb	19	<10 - 700	17 (M)			<20 - 80	10
Rb	67	<20 - 210	35 (M)	100			
S, total	1,600	<800 - 48,000	100 - 2,000	850			
Sb	.66	<1 - 8.8	2 (A)				.5
Sc	8.9	<5 - 50		7		<3 - 15	
Se	.39	<0.1 - 4.3	0.31 (M)	.001			.5
Si	310,000	16,000 - 450,000		330,000			
Sn	1.3	<0.1 - 10	10 (A)				10
Sr	240	<5 - 3,000	67 (M)	300		60 - 700	300
Ti	2,900	70 - 20,000		4,600	1,200 - 6,000		
Th	9.4	2.2 - 31					13
U	2.7	0.29 - 11	1 (A)				1
V	80	<7 - 500	57 (M)	100		20 - 250	100
Y	25	<10 - 200		50		25 - 100	
Yb	3.1	<1 - 50					
Zn	60	<5 - 2,900	36 (M)	50			50
Zr	230	<20 - 2,000	270 (M)	300		200 - >1,000	

[1]Author's usage; generally used to indicate the most commonly occurring value.

collected by U.S. Geological Survey personnel along their routes of travel to areas of other types of field studies or within their project areas.

The locations of the routes that were sampled depended on both the network of roads that existed and the destinations of the samplers. Sampling intensity was kept at a minimum by selecting only one sampling site every 80 km (about 50 miles; selected for convenience because vehicle odometers were calibrated in miles) along the routes. The specific sampling sites were selected, insofar as possible, that had surficial materials that were very little altered from their natural condition and that supported native plants suitable for sampling. In practice, this site selection necessitated sampling away from roadcuts and fills. In some areas, only cultivated fields and plants were available for sampling.

Contamination of the sampling sites by vehicular emissions was seemingly insignificant, even though many sites were within 100 m or less of the roads. Col-

1, unlike the geometric means shown in table 2, are estimates of geochemical abundance (Miesch, 1967). Arithmetic means are always larger than corresponding geometric means (Miesch, 1967, p. B1) and are estimates of the fractional part of a single specimen that consists of the element of concern rather than of the typical concentration of the element in a suite of samples.

Concentrations of 46 elements in samples of this study are presented in table 2, which gives the determination ratios, geometric-mean concentrations and deviations, and observed ranges in concentrations. The analytical data for most elements as received from the laboratories were transformed into logarithms because of the tendency for elements in natural materials, particularly the trace elements, to have positively skewed

TABLE 2.—*Mean concentrations, deviations, and ranges of elements in samples of soils and other surficial materials in the conterminous United States*

[Means and ranges are reported in parts per million (μg/g), and means and deviations are geometric except as indicated. Ratio, number of samples in which the element was found in measurable concentrations to number of samples analyzed. <, less than; >, greater than]

Element	Conterminous United States			Western United States (west of 96th meridian)					Eastern United States (east of 96th meridian)				
	Mean	Deviation	Estimated arithmetic mean	Ratio	Mean	Deviation	Observed range	Estimated arithmetic mean	Ratio	Mean	Deviation	Observed range	Estimated arithmetic mean
Al, percent	4.7	2.48	7.2	661:770	5.8	2.00	0.5 - >10	7.4	450:477	3.3	2.87	0.7 - >10	5.7
As	5.2	2.23	7.2	728:730	5.5	1.98	<0.10 - 97	7.0	521:527	4.8	2.56	<0.1 - 73	7.4
B	26	1.97	33	506:778	23	1.99	<20 - 300	29	425:541	31	1.88	<20 - 150	38
Ba	440	2.14	580	778:778	580	1.72	70 - 5,000	670	541:541	290	2.35	30 - 1,500	420
Be	.63	2.38	.92	310:778	.68	2.30	<1 - 15	.97	169:525	.55	2.53	<1 - 7	.85
Br	.56	2.50	.85	113:220	.52	2.74	<0.5 - 11	.86	78:128	.62	2.18	<0.5 - 5.3	.85
C, percent	1.6	2.57	2.5	250:250	1.7	2.37	0.16 - 10	2.5	162:162	1.5	2.88	0.06 - 37	2.6
Ca, percent	.92	4.00	2.4	777:777	1.8	3.05	0.06 - 32	3.3	514:514	.34	3.08	0.01 - 28	.63
Ce	63	1.78	75	81:683	65	1.71	<150 - 300	75	70:489	63	1.85	<150 - 300	76
Co	6.7	2.19	9.1	698:778	7.1	1.97	<3 - 50	9.0	403:533	5.9	2.57	<0.3 - 70	9.2
Cr	37	2.37	54	778:778	41	2.19	3 - 2,000	56	541:541	33	2.60	1 - 1,000	52
Cu	17	2.44	25	778:778	21	2.07	2 - 300	27	523:533	13	2.80	<1 - 700	22
F	210	3.34	430	598:610	280	2.52	<10 - 1,900	440	390:435	130	4.19	<10 - 3,700	360
Fe, percent	1.8	2.38	2.6	776:777	2.1	1.95	0.1 - >10	2.6	539:540	1.4	2.87	0.01 - >10	2.5
Ga	13	2.03	17	767:776	16	1.68	<5 - 70	19	431:540	9.3	2.38	<5 - 70	14
Ge	1.2	1.37	1.2	224:224	1.2	1.32	0.58 - 2.5	1.2	130:131	1.1	1.45	<0.1 - 2.0	1.2
Hg	.058	2.52	.089	729:733	.046	2.33	<0.01 - 4.6	.065	534:534	.081	2.52	0.01 - 3.4	.12
I	.75	2.63	1.2	169:246	.79	2.55	<0.5 - 9.6	1.2	90:153	.68	2.81	<0.5 - 7.0	1.2
K, percent[1]	1.5	.79	None	777:777	1.8	.71	0.19 - 6.3	None	537:537	1.2	.75	0.005 - 3.7	--
La	30	1.92	37	462:777	30	1.89	<30 - 200	37	294:516	29	1.98	<30 - 200	37
Li	20	1.85	24	731:731	22	1.58	5 - 130	25	479:527	17	2.16	<5 - 140	22
Mg, percent	.44	3.28	.90	777:778	.74	2.21	0.03 - >10	1.0	528:528	.21	3.55	0.005 - 5	.46
Mn	330	2.77	550	777:777	380	1.98	30 - 5,000	480	537:540	260	3.82	<2 - 7,000	640
Mo	.59	2.72	.97	57:774	.85	2.17	<3 - 7	1.1	32:524	.32	3.93	<3 - 15	.79
Na, percent	.59	3.27	1.2	744:744	.97	1.95	0.05 - 10	1.2	363:449	.25	4.55	<0.05 - 5	.78
Nb	9.3	1.75	11	418:771	8.7	1.82	<10 - 100	10	322:498	10	1.65	<10 - 50	12
Nd	40	1.68	46	120:538	36	1.76	<70 - 300	43	109:332	46	1.58	<70 - 300	51
Ni	13	2.31	19	747:778	15	2.10	<5 - 700	19	443:540	11	2.64	<5 - 700	18
P	260	2.67	430	524:524	320	2.33	40 - 4,500	460	380:382	200	2.95	<20 - 6,800	360
Pb	16	1.86	19	712:778	17	1.80	<10 - 700	20	422:541	14	1.95	<10 - 300	17
Rb	58	1.72	67	221:224	69	1.50	<20 - 210	74	107:131	43	1.94	<20 - 160	53
S, percent	.12	2.04	.16	34:224	.13	2.37	<0.08 - 4.8	.19	20:131	.10	1.34	<0.08 - 0.31	.11
Sb	.48	2.27	.67	35:223	.47	2.15	<1 - 2.6	.62	31:131	.52	2.38	<1 - 8.8	.76
Sc	7.5	1.82	8.9	685:778	8.2	1.74	<5 - 50	9.6	389:526	6.5	1.90	<5 - 30	8.0
Se	.26	2.46	.39	590:733	.23	2.43	<0.1 - 4.3	.34	449:534	.30	2.44	<0.1 - 3.9	.45
Si, percent[1]	31	6.48	None	250:250	30	5.70	15 - 44	None	156:156	34	6.64	1.7 - 45	--
Sn	.89	2.36	1.3	218:224	.90	2.11	<0.1 - 7.4	1.2	123:131	.86	2.81	<0.1 - 10	1.5
Sr	120	3.30	240	778:778	200	2.16	10 - 3,000	270	501:540	53	3.61	<5 - 700	120
Ti, percent	.24	1.89	.29	777:777	.22	1.78	0.05 - 2.0	.26	540:540	.28	2.00	0.007 - 1.5	.35
Th	8.6	1.53	9.4	195:195	9.1	1.49	2.4 - 31	9.8	102:102	7.7	1.58	2.2 - 23	8.6
U	2.3	1.73	2.7	224:224	2.5	1.45	0.68 - 7.9	2.7	130:130	2.1	2.12	0.29 - 11	2.7
V	58	2.25	80	778:778	70	1.95	7 - 500	88	516:541	43	2.51	<7 - 300	66
Y	21	1.78	25	759:778	22	1.66	<10 - 150	25	477:541	20	1.97	<10 - 200	25
Yb	2.6	1.79	3.1	754:764	2.6	1.63	<1 - 20	3.0	452:486	2.6	2.06	<1 - 50	3.3
Zn	48	1.95	60	766:766	55	1.79	10 - 2,100	65	473:482	40	2.11	<5 - 2,900	52
Zr	180	1.91	230	777:778	160	1.77	<20 - 1,500	190	539:541	220	2.01	<20 - 2,000	290

[1]Means are arithmetic, deviations are standard.

REFERENCE 31

HANDBOOK OF ENVIRONMENTAL DATA ON ORGANIC CHEMICALS

SECOND EDITION

Karel Verschueren

Environmental Advisor
Heidemij/Adviesbureau
and
Department of Public Health and Tropical Hygiene
Agricultural University of Wageningen
Netherlands

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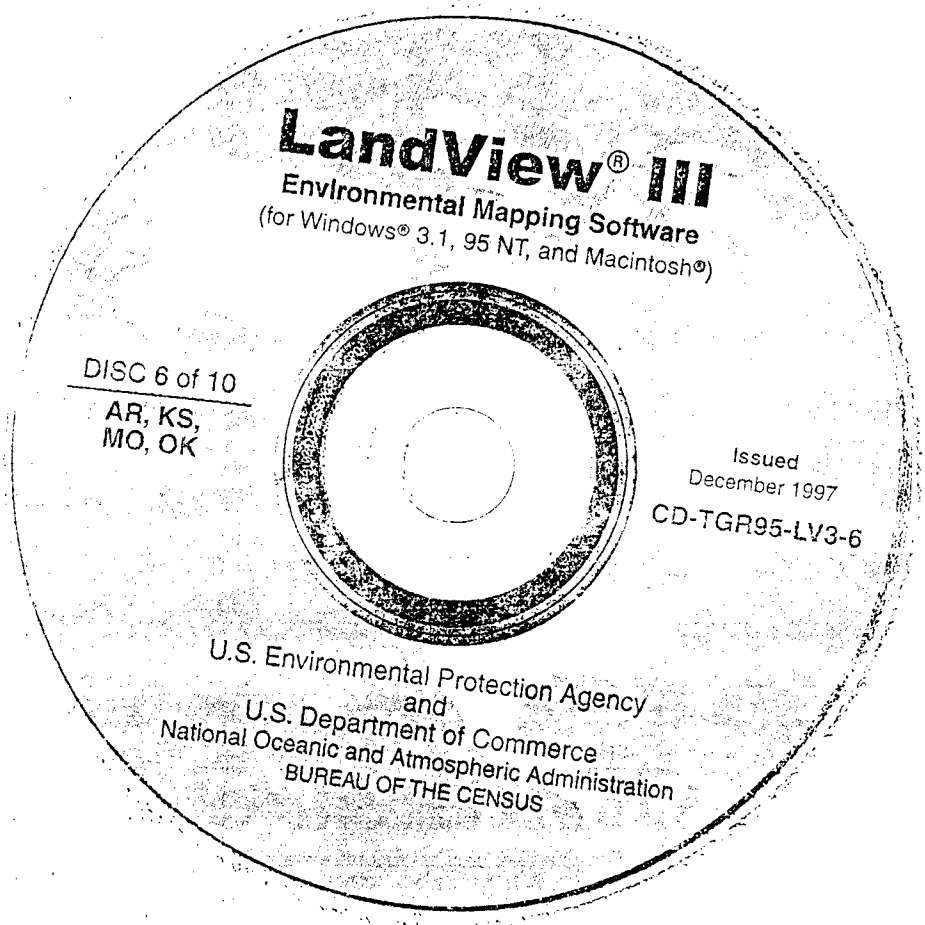

Introduction to the LandView III CD-ROM

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